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[OFFICIAL NOTICE.]

Thirty-sixth Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
SECRETARY'S OFFICE, 26 CENTRAL SQUARE,
EAST BOSTON, MASS., January 8, 1906.

The 36th Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Tuesday and Wednesday, February 20th and 21st, 1906. The usual number of papers are in course of preparation and, with numerous questions sent in for discussion, the time of the meeting promises to be fully occupied. Members will please note the change from the usual days, on account of Thursday being a holiday. Detailed information regarding the programme, etc., will be mailed to members before the meeting, so that each may come prepared to do his full share, and make the meeting more successful than its predecessors. N. W. GIFFORD, Secretary.

[NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF THE WRINKLE DEPT.,
719 CITIZENS BUILDING,
CLEVELAND, O., June 13, 1905.

The Wrinkle Department of the Ohio Gas Light Association is now ready to receive contributions for the 1906 collection, and a sketch or description of all devices, formulæ and methods of accomplishing objects pertaining to the gas business, is respectfully solicited.

Please send a written explanation, accompanied by any sketch, photograph or drawing, to the above address, or a description alone will suffice.

Hoping to receive prompt compliance,

Yours very truly, W. E. STEINWEDELL, Editor.

BRIEFLY TOLD.

A TRIFLE PREMATURE.—The members of the New York State Commission on Gas and Electricity were quite disturbed last week, and with good reason too, over a widespread report that was said to have been semi-officially promulgated by them that the Commission had decided to reduce the selling rate for gas in New York city to 95 cents per 1,000 cubic feet, with a sliding scale reduction of 5 cents per 1,000 for each succeeding year until the minimum rate of 80 cents per 1,000 was reached. On the 18th inst. the New York *Sun* quoted President Gunnison as having said that the investigation being conducted by the Commission was not anywhere near a termination. He thought it would take about another week before the hearing of testimony respecting the Consolidated Company was completed, at which time the investigation would be about half finished. Under the circumstances he thought it was up to the prognosticators to hold their peace, for they could certainly not know more than the judges.

NOTES—

MR. MAURICE S. DECKER, formerly President of the Waverly (N. Y.) Gas Company, died at his home in Orange, N. J., early this month.

MR. J. H. WALKER has been elected President of the Progress Club of the Milwaukee Gas Light Company. The other officers chosen were: Vice-President, Frederick Glahn; Secretary-Treasurer, Ross C. Cornish; Librarian, F. P. Kelsey. At the annual meeting, Dr. Harrop delivered an interesting lecture on "gas lighting," his theme being largely devoted to the chemistry of the subject.

MR. ALVAH A. MALLOY died in Sacramento, Cal., the 5th inst. He was in his 63d year, and was one of the organizers of the Nevada City (Cal.) Gas Company.

AT the annual meeting of the Peoples Gas Company, of Cleveland, O., the officers elected were: Directors, G. H. Warmington, D. R. Warmington, C. H. Beardslee, M. A. Bradley and J. M. Carrington; President, G. H. Warmington; Vice-President and General Manager, David R. Warmington; Secretary and Treasurer, W. K. Hadden.

MESSRS. FREDERICK A. PLATT, William L. Jenks and Henry L. Hawley have applied for papers incorporating the Hoopeston Gas and Electric Company, of Hoopeston, Ills.

Factory Education.

Iron Age says that the necessity of providing agencies for training boys to become mechanics, in addition to the restricted opportunities afforded in the trades as now conducted and controlled, is receiving widespread attention. The problem is a difficult one but it is being handled in some fashion in nearly every industrial community. Related to this question, and fully as important if not more so, is the matter of providing the training through which can be secured the material for expert superintendence. The old workshop in which a man of parts developed into a well rounded mechanic, able to instruct and direct others, has largely given way to the factory with every hand working at some specialty. In such an establishment the conditions are usually unfavorable for the development of those qualifications which fit a man for superintendence. Here the factory system breaks down. For its own advancement the system needs a competent supply of men well qualified to direct others and it fails to produce them. Discussing this point in an article in *Machinery* on "Factory Education," O. M. Becker says:

"Most managers have experienced the difficulty of getting the right man for the place, especially if the place were one requiring considerable knowledge of the business as a whole. An industry is lacking in some respects if it cannot to a considerable extent train up the men who are later to be the directing forces in it. Most businesses are not now doing it. Nor on the basis of present systems is it possible to be done.

"There are evidently two methods of attack in the solution of this problem; increasing facilities for industrial and technical education, that is, for the adequate training of workers for their work, and a modification of the piecework system of labor. The latter may be neglected in this discussion, for the reason that as yet there appears to be at hand no practicable substitute that is economically as satisfactory. There remains, then, the other alternative, that of education. Factory education, or perhaps better stated the education of factory operatives, is not an untried theory of the idealist. Level-headed men have long seen the economic necessity for something of the sort, and as long ago as the time of Robert Owen factory schools were more or less effective agencies in the development of certain industries.

"The old apprentice system, inefficient as it was from the modern point of view, was one manifestation of the idea and a powerful factor in the promotion of industrial progress. Its wastefulness of time and the development of the specialized machine tool have led to its practical disappearance, unfortunately leaving no organized means for the accomplishment of its purposes in its stead. A few far-sighted employers of large interests, to their great advantage, as they stoutly maintain, have retained the apprenticeship system in a modified form, and make it part of an educational system conducted along with and as a part of their manufacturing plants. The Baldwin Locomotive Works, the Brown & Sharpe Manufacturing Company, the General Electric Company, and R. Hoe & Company may be mentioned as notable examples in this country. The school conducted at the Hoe printing press works for more than 30 years has developed to such an extent that it is recognized as one of the leading private trade schools in the country. From it go out, usually after some years' additional service with the company, men who take responsible positions in manufacturing plants all over the country."

[Prepared for the JOURNAL by MR. WILLIAM H. COLE, Newton, Mass.]

Electrolytic Action and Gas Mains.

In the December 25th, 1905, issue of the AMERICAN GAS LIGHT JOURNAL, I noticed a report of the discussion on the paper[1] read by Mr. H. L. Rice before the last meeting of the American Gas Light Association. With reference to that part of it dealing with electrolytic destruction of gas mains, it seems to the writer that the average gas man has a somewhat confused idea of the flow of electricity along the various paths presented to it, and also as to the responsibility of railway companies for damage done by stray currents.

Railway companies are probably morally bound to, and are indeed financially interested in maintaining a sufficient metallic return for their current to the source of power. They do not depend in the slightest degree upon the conductivity of the underground systems of pipes, be they water or gas, for the successful operation of their cars. They realize that the investment necessary to secure good bonding and return feeders pays well in saving of coal and an improved service, and as a general rule are able to declare without successful contradiction that the ground return installed by them is ample for the successful conduct of their business whether or not there be pipe systems adjacent to their tracks. Wherever the responsibility may finally be placed, the probable duty of the gas or water distributer at present lies along lines of self protection, and until the question is settled he should use any and all means known to the art to preserve his pipe system, and protect it from the ravages of electrolytic action.

Referring to the discussion as to the relative merits of bonding and insulating sections of pipe to prevent the inroads of electrolytic action, I do not agree with Mr. Brownell and Prof. Burgess in their emphatic condemnation of insulating joints, nor do I entirely disagree with the expressions made by different gentlemen as to the efficacy of a *well* bonded pipe system, although I can conceive of conditions where bonding would be worse than useless.

Referring briefly to the fact that gas engineers are to a large extent somewhat hazy on the subject of electrical resistance and current flow, and at times ready to accept as positive facts the opinions of alleged electrical experts, it may be well to state that the flow of electricity through the earth and metallic conductors is proportional to the conductivity of the separate paths, and that difference of potential or electrical pressure is not in itself indicative of the amount of current flowing between the two points where the difference of potential is observed. It is generally understood at the present time, however, that damaging electrolytic action takes place only where the electric current leaves a metallic conductor and passes into a non-metallic conducting medium in the presence of moisture, which may or may not be of an acid or alkaline nature. The damage from purely galvanic action between dissimilar metals is of not much moment, except where the two or more metals are submerged in a fairly good conducting medium such as sea water.

In considering the return paths for the trolley current let us assume the parallel presence of bonded rails, gas and water mains, and "Mother Earth." The first two paths mentioned are metallic and of definite cross-sectional area, and of fairly definite resistance or conductivity. The third path, or the earth, is very indefinite in cross-section, and likewise indefinite in conductivity.

Comparing relative resistances of equal cross-sectional areas of the three above mentioned return paths, we find that the average resistance of the earth is very high, but on the other hand the cross-section of the earth return path may be so great that its resistance as a whole may be relatively small, and, barring streaks of high conductivity, the density of current per unit area of the soil will have a very low value.

From the above I maintain, and I think I am borne out in my opinion by a number of qualified engineers, that pipe systems as a whole collect their electricity over a large negative area—that is, where pipes are negative to the rails—and discharge it to the trolley ground return in the positive area, which is generally more restricted, due to the fact that the power house is permanently fixed, while the cars are running all over the track system. This restriction in positive area leads to a concentrated discharge which may be over such an area as to be a long time causing trouble, or will, provided the earth in this positive area is of relatively high conductivity in streaks, discharge at points causing the damage to be highly concentrated, which is shown by fairly well defined holes eaten in pipes so damaged.

I further maintain that if restrictions are properly placed in pipe lines so as to prevent the collection of this current in the negative district,

1. "High Pressure Gas Distribution of To-day;" JOURNAL, Nov. 13, 1905; p. 7[illegible]; by M. H. L. Rice, Aurora, Ills.

there will substantially be no current to be discharged in the positive districts. Therefore, using insulating, or, to be more exact, high resistance joints with every length of pipe prevents each section of pipe in the negative area from taking up its small increment of current, which, if there were no insulating joints, would be carried along the line and added to the collection of all other sections of pipe in the negative area, finally leaving the pipe system in the positive area, doing damage which may or may not be distributed and, therefore, take a greater or less time to become evident.

Inasmuch as the average difference of potential per 12 feet of track, even at heavy loads, is very small, it follows that a parallel length of pipe would not have a substantially greater difference, and, as was pointed out in the discussion, the earth's resistance is very high per unit of area, this very small pressure existing at each point would not force any appreciable current around the insulated joint, and, therefore, no damage would result. Ample proof of this theory is found in the case of cast iron mains made up with cement joints, which have a relatively low resistance and may not be classed as insulating joints.

Many miles of these cement joint gas mains have been in use for a great many years in a territory where a great deal of electric railroading is done.

Referring to the installation of insulating joints at North Adams, Mass., where they were used approximately every 500 feet on a wrought iron line. In this case the use of only one joint in 500 feet was an ill-advised absurdity, and would be comparable with the action of a railway company which bonded its rails every 500 feet and expected to get a return of high conductivity, for in one case resistance was aimed at with 10 joints per mile of pipe with line a good conductor between, and in the other conductivity was wanted and expected with only 10 bonds per mile with resistance between at every rail joint. Such track bonding would be absurd, but no more so than the parallel case of pipe insulation referred to.

The very fact that pipes are buried in the earth requires the free use of insulating joints to minimize the effects of conducting streaks, and to split up the difference of potential along the trolley return circuit so that the separate differences of potential will be so small as to be unable to force any appreciable current around a joint.

Assuming the North Adams line to have 30 insulated joints each side of the power house, and that the maximum loss of voltage in the track return be 200 volts, which by-the-way would represent worse than poor practice, we have, dividing this 200 volts by 30 joints, an average potential of 6⅔ volts available at each joint to force current around through the earth. Furthermore, the long length of undivided pipe between joints presents a great area to the earth and permits of current entering and leaving over comparatively large surfaces. This reduces many fold the resistance through earth around joints, due to the greatly increased area of the earth path, and consequently defeats the the very purpose for which the joints were introduced.

Now, then, let us see what the conditions would have been had this line been laid with 12-foot lengths with insulated joint at each length.

Assuming that 200 volts was lost in the return path of the trolley as before, we have in 3 miles of pipe, or 1,200 joints, a pressure averaging at each joint $\frac{200}{1200}$, or ⅙ volt. This insignificant pressure would, of course, act to force current around each joint, but while we have cut down the joint pressure we have also added greatly to the earth resistance around the joint by cutting down the area of pipe between joints, and consequently the cross section of the earth path around the joints.

Closing, with a few words in regard to the efficiency of bonding pipes to each other and to the trolley rails, there is no doubt that if properly installed and maintained such bonding would be successful in some few cases, but in my judgment such action savors of cowardice, and furthermore establishes a bad precedent which may have a bearing on the final placing of responsibility for electrolytic damage throughout the country.

If you work in the other direction, and keep the current off your lines, you may at least know that you have attempted to save your property without admitting responsibility.

At the annual meeting of the Slatington (Pa.) Gas Company the officers elected were: Directors, W. L. Jones, Joseph Richards, A. L. Kistler, John Taylor, Guy R. Jones, H. M. Hower, Robert G. Pierce; President, W. L. Jones; Vice-President, A. L. Kistler; Treasurer, Joseph Richards; Secretary, H. E. Graffin.

"Chats" on Igniters and Exploders.

By Observer.

Although apparatus for igniting the charge in gas, gasoline and oil engines has multiplied in the past few years, the devices may be readily classified for convenience. There are four kinds in general use, and each kind varies some in detail of construction, design, finish, action or process of ignition, yet the principle is practically the same in all. The simplest, and possibly the most used form of ignition, may be placed under the heading of the direct-flame system. In this device the flame comes into contact with the gases at the proper moment for ignition, resulting in the movement of the piston. In some of the styles of 2-cycle, non-compression engines of motors, the explosion takes place when the gas and air components are completely mixed. I will refer briefly to the operation of electric ignition in this article. There are, as is known, three principles of operation in the processes of electric ignition as now used. There is the secondary current sparking method, in which the battery and induction coil combine to form the spark necessary to ignite the charge at a point between two electrodes; then there is ignition by direct current from a dynamo.

In this system the current is manipulated by a current breaker worked by a cam. The attached diagrams will assist in making some explanation of the movements. An electric igniter is shown in Fig. 1. The battery is located as shown, and is connected up with the sparking coil, as indicated by the line of wires. The current is taken down through the wire leading to the upper electrode, and back again through the other electrode. The electrodes are signified *A*, *A*; and are properly insulated in porcelain *B*. The tubes are arranged to carry the wires to the point inside the cylinder where the ignition is to take place. The idea is to carry the spark as near as possible to the charge of mixture of air and vapor. The plan of the sparking coil is shown in Fig. 2. It is constructed by making up a cluster of wire for a central core *C*. This core of iron wire is insulated and then wound with insulated copper wire. The winding is done evenly and securely. The breaking device operates on the usual plan. Sometimes the insulation used for the space between the inner and outer wiring is as marked at *E*. The outer system of wires is designated *D*.

The reciprocating rod, spark-breaking arrangement is shown in the diagram in Fig. 3. This is a double igniter, in which the breaker is

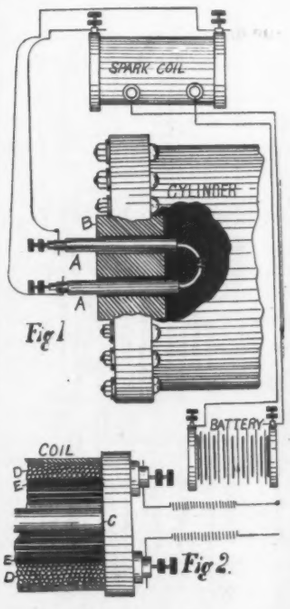


Fig 1

Fig 2.

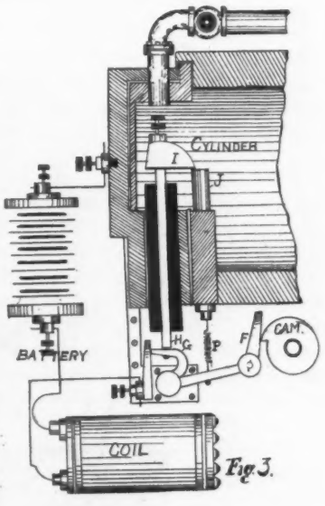


Fig 3.

joined to the piston. There is a contacting lever *I* on the insulated rod, and there is also a cam device which operates the part *F* in such way that the lever *I* is retained at its contacting point with *J*, so long as the cam is in its present position. As soon as the cam releases the lever the latter springs back, due to the action of the spring *P*. This spiral spring is of ample power to lift the electrode *H*. Thus the part *I* is elevated from *J* at the proper time and the breaking of the circuit produces the spark. The sparking can be controlled by the adjustment of the insulated rod. Sometimes the oxidizing properties of metals cause trouble in the mechanism of the igniters, but the employment of porcelain tubes has overcome very much of this trouble. The constant repeated ham-

merings of the explosions often result in premature wear of parts, as is known to motorists and others using the engines. Often the intensity of the heat playing directly upon a tube causes undue wear. Crystallization and oxidation often arise. The lubrication of the parts is a matter of moment. The explosive motors and hot gases play havoc with parts of the engine.

The tendency in some instances is to produce a gummy lining of oil on the parts, therefore, it is wisdom to select lubricating oils that are adapted to severe heat tests. The oil should be capable of flowing just enough so that it cannot get forced into the combustion chamber in excess and choke the interior with the troublesome grease soot with which we so often come in contact. Internal cleaning of the explosive types of motors is necessary at intervals. I have seen some that needed monthly cleaning. Others require cleaning only once in 3 months. When cleaning look out for leaks. Leaks occur when the piston is worn, when valves are defective or pip s disordered. After several miss-fires in your engine, trouble may be produced by premature explosion of the gathered combustible mixture. In fact some serious accidents have occured because of this. When there is a miss-fire at the igniter, the charge is either increased at next ignition, or the explosion may occur in the pipes, such as in the exhaust, as in some types of engines The irregular operation of the valves, or the igniting mechanism, may be the cause. The gumming of the spindle, weakness in the spring, and the like, may be the cause. Sometimes the muffler-pots collect the moisture condensed by the union of hydrogen and oxygen of the gas and the air, and trouble arises when the circulation is stopped.

Vertical Retorts for Producing Coal Gas and Water Gas.[1]

A French patent has been taken out by M. Rummens for a setting of vertical retorts for the simultaneous production of a mixture of coal gas and water gas. His specification is given in the last number of the *Journal de l'Eclairage au Gaz et à l'Electricité*, from which the following particulars are extracted:

The general arrangement of the setting is shown in the accompanying illustrations. The retorts have double walls *A* and movable bottoms *B*. The outer wall is solid and vertical, while the inner one is perforated and inclined in such a way that the retorts are of smaller section at the top than at the bottom. Consequently, on the withdrawal of the sliding bottoms, the incandescent coke falls by its own weight into closed receptacles *C* beneath without being cooled by contact with the outer air. This coke serves to generate superheated steam, produced by the injection of water into vaporizing appliances *D* placed in the closed receptacles in the midst of the mass of coke. The steam escapes by two pipes screwed at one end into the lower part of the retort, and the other ending in a vertical opening made in the center of blocks of refractory material supporting the retorts. By means of this opening, the superheated steam is conveyed directly into the retorts, and is there converted into water gas which mixes at a high temperature with the coal gas in course of production.

Referring to the illustrations, Fig. 1 is a longitudinal vertical section of the setting and of the generators placed at either end; while Fig. 2 is a transverse vertical section—the portion to the left being in the axis of a vertical retort, and that on the right in the axis between two retorts. The object of the double wall of the retorts is to allow the gas to reach the ascension pipes, and from them to pass into the hydraulic main, without having to make its way through the charge of coal in process of carbonization; its course being through the perforations in the inner wall of the retort. The two walls are closed at the top by a mouthpiece *E*, into which the ascension pipe *F* (Fig. 2) enters. The combustion chambers *G*, are heated by means of gaseous fuel produced in the vertical generators. It is in the former that the gaseous fuel meets the secondary air arriving in the opposite direction; and the resulting flames rise into all the spaces separating the retorts, surround the latter and heat them uniformly. The closed receptacle under each vertical retort has at its lowest extremity an opening by which the cold coke may be drawn out before a fresh charge of incandescent coke is allowed to fall into it.

In the setting of retorts devised by the inventor there are three different periods of distillation: (1) A period during which, until a temperature between 500° and 900° C. has been reached, only coal gas of good quality will be produced. (2) A period during which, by maintaining the temperature in the retorts above 700° C., by superheating them by means of generators, and by suitably regulating the injection of water, there will be produced, once or several times, a highly economical mixture of coal gas and water gas of good quality. (3) A period during which, by carbonizing coal at high temperature—*i. e.*, from 700° C. up to 1,200° C.—a large quantity of coal gas will be obtained, but of a lower quality than that produced during the first period. The retorts are furnished with an automatic charger *H* which permits the rapid and simultaneous charging of all the retorts in a setting, irrespective of their

1. *Journal of Gas Lighting.*

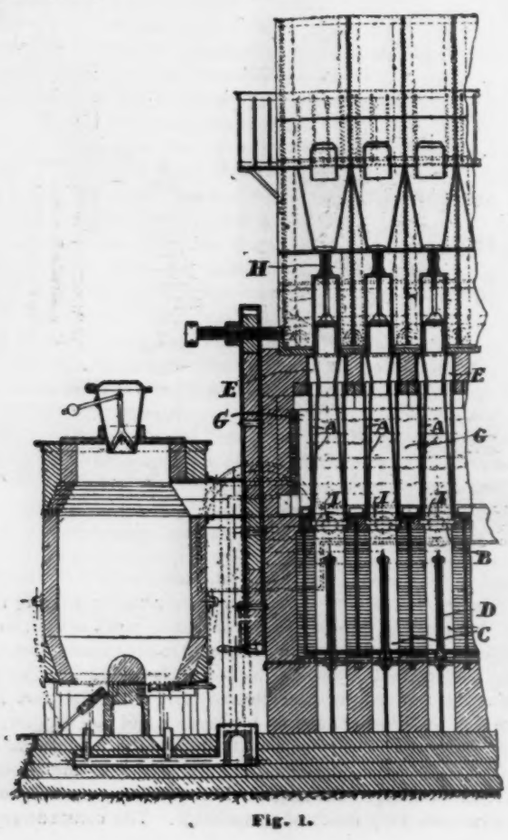


Fig. 1.

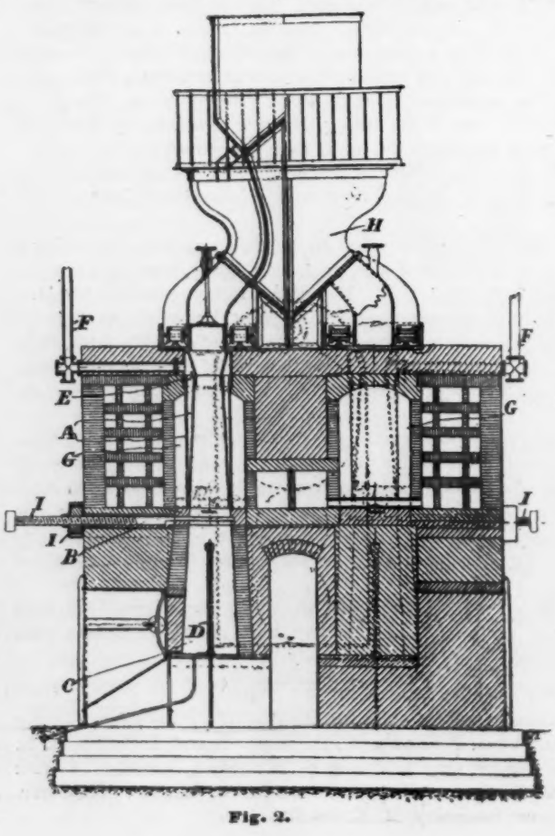


Fig. 2.

number. This is claimed to be an entirely new feature in retort stoking.

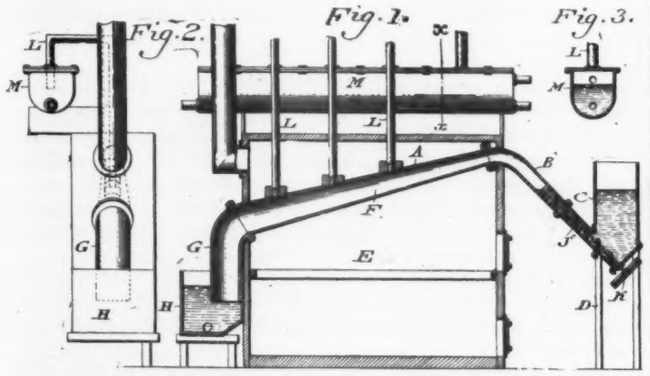
Before each fresh charging of the retorts, they must, of course, have been thoroughly emptied of the incandescent coke by causing it to fall into the receptacles already referred to. This is done by simultaneously drawing all the sliding bottoms of the retorts, which is effected by means of the mechanism shown at *I* in the diagrams.

The Hartman Gas Generator.

On December 26th, 1905, United States Letters Patent (No. 808,365) were granted to Mr. Henry A. Hartman, of Philadelphia, Pa., for a "New and useful gas generator." Using the words of the specification:

My invention consists of a gas generator having a retort of novel construction whereby fuel may be readily directed through the main body of the same by its own gravity without necessarily requiring means to occasion said passage, while also providing means for preventing clogging of the fuel and coke in the retort, while the latter presents a large surface to the action of the heat of the furnace.

Fig. 1 represents a partial elevation and partial vertical section of a gas generator embodying my invention. Fig. 2 represents an end elevation thereof. Fig. 3 represents a vertical section of a portion on line *x x*, Fig. 1.



Similar letters of reference indicate corresponding parts in the figures.

Referring to the drawings, *A* designates a retort which is elbow shaped and has one limb *B*, opening into the water column *C*, said column being mounted on the supports *D* and constituting a hopper. *E* designates a furnace over which the limb or main body *F* of the retort *A* is supported, said limb thus being adapted to be subjected to the heat of said furnace. On the end of the limb *F* opposite to the limb *B* is a downwardly-deflected limb *G*, which forms a continuity of the limb *F* and opens into the tank *H*, which is properly supported and adapted to receive water or other fluid, it being noticed that the retort *A* is of conical form, so as to increase in diameter in the direction from its inlet at the column *C* to its discharge or outlet at the tank *H*.

Within the limb *B* is a spiral conveyer *J*, which is partly continued into the column *C*, the shaft of said conveyer having connected with it the pulley *K*, to which power may be communicated in any suitable manner, so as to rotate said conveyer.

Rising from the retort *A* are the pipes *L*, which are in communication with the same and with the main *M*, the latter being supported in any suitable manner above the furnace.

The operation is as follows: Coal is introduced into the column *C*, and consequently made wet by the water therein. As the conveyer *J* rotates, the coal, in wet condition, is raised by the same into the limb *B* and forced into the main limb *F*, where it is subjected to the heating action of the furnace, and thus coal gas will result. At the same time as more coal reaches the upper portion of the limb *F* the water therefrom will pass down the limb *F* and be converted into steam, which must pass through the hot coal in order to reach the take-off pipes *L*, thus adding a percentage of gas to the larger quantity of coal gas made. The coke resulting from the treatment of the coal will be directed from the limb *F* into the limb *G*, from which it will be dropped into the tank *H* and cooled by the water therein, after which it may be discharged from said tank in any suitable manner.

It will be noticed that owing to the conical or widening shape of the retort the coal successively entering the limbs *B* and *F* will be prevented from clogging therein, and so will discharge therefrom in a reliable manner, the coke formed in the limb *F* also being prevented from clogging therein as well as in the limb *G*.

Various changes may be made in the details of construction shown without departing from the general spirit of my invention, and I do not, therefore, desire to be limited in this case to the same.

The inventor's claims are:

1. In a gas generator, a retort having a body and a supply limb at an angle thereto, the said body and limb being inclined downwardly in opposite directions from their supply to their discharge ends, said body portion and limb increasing in diameter from the inlet to the discharge ends thereof.

2. In a gas generator, a retort having a body and a supply limb, at an angle thereto, the said body and limb being inclined downwardly in opposite directions from their supply to their discharge ends and said body portion and limb increasing in diameter from the inlet to the discharge ends thereof and a downwardly extended limb at the larger end of the body.

3. In a gas generator, a retort increasing in diameter from its inlet to its discharge end and consisting of a body having a downwardly deflected supply limb at one end thereof and a downwardly extending discharge limb at the other end thereof, a water receiving hopper and a water receiving tank, the supply limb entering said water receiving hopper and the discharge limb entering the water receiving hopper and an elevator in said supply limb.

4. In a gas generator, a retort increasing in diameter from its inlet to its discharge end, a furnace below the body portion of said retort, a supply limb at one end of said body, a discharge limb at the other end thereof, an elevator in said supply limb, a water receiving hopper with which said supply limb is in communication and a water receiving tank into which dips said discharge limb.

5. In a gas generator, a retort of elbow form, of gradually increasing diameter, means for supporting the same in inclined position, a supply limb at the inlet end thereof, an elevator in said supply limb and a hopper in communication with said supply limb, said elevator partly entering said hopper.

The Coals of Illinois.

Mr. S. W. Parr, Professor of Applied Chemistry, University of Illinois, writing on the subject named in the heading, in a communication to the *Engineering and Mining Journal*, says:

The total output of coal from all mines in Illinois in 1904 (23d Annual Report, Illinois Bureau of Labor Statistics) was 37,000,000 tons, with a valuation at the mines of over $40,000,000. A conservative estimate for the year 1905 would place the output in excess of 40,000,000 tons. It will thus be seen that Illinois ranks next to Pennsylvania in the tonnage and value of coal output.

There are 8 geological seams in the State, which are of commercial importance in the production of coal. The original classification by Dr. Worthen, in the first geological survey, has served for the designation of these seams up to the present time, although uncertainty as to the correctness of the numbering and also as to the continuity of the seams as interpreted for all localities calls for a careful review of the designations now in use, and perhaps the devising of a better system. It is of interest to note in this connection that there is just being inaugurated a new geological survey under the directorship of Dr. H. F. Bain, with headquarters at the University of Illinois.

Using, however, the numerals now in vogue, beginning with the lowest (or in point of geological time the first) and counting upward, the producing seams are the 1st, 2d, 3d, 4th, 5th, 6th, 7th and 14th. In point of commercial importance the interest resides almost wholly in seams numbered 1, 2, 5, 6 and 7, the combined output of the seams numbered 3, 4 and 14 amounting to barely 0.1 per cent. of the total output of the other 5 seams.

In general it may be said that seam No. 1 supplies about 2 per cent. of the output of the State; the working localities are in the extreme northwest border of the coal area, mainly in Mercer county. Seam No. 2, which furnishes approximately 14 per cent. of the output, is mined in the extreme northern and northeastern and southwestern borders of the coal area, representative centers being Spring Valley and Braceville in the north, and Murphysboro in the south. Seam No. 5 produces 35 per cent. of the output, Sangamon county alone furnishing one third of this amount, the rest coming mainly from Fulton, Peoria, Menard and Logan counties. It will thus be seen that the min-

ing of the fifth seam is chiefly confined to the northern half of the coal area. The southern half of the area furnishes coal mainly from the sixth vein, 35 per cent. of the entire yield of the State coming from this source.

Seam No. 7 is mined in the extreme southern part of the State, in Williamson county, and also in the extreme eastern section in Vermilion county, the output from this vein amounting to about 14 per cent. of the total.

There is no relation between the number of the seam and the distance from the surface of the deposit. For example, the major part of seam No. 1 is worked at a depth of less than 200 feet, though an isolated working of this seam at Assumption is carried on at a depth of 1,000 feet, by far the deepest mine in the State. Somewhat roughly estimated it may be said that 10 per cent. of the output is mined at a depth of less than 100 feet; 45 per cent. is mined at a depth of from 100 to 200 feet; 20 per cent. from 200 to 300 feet; 15 per cent. from 300 to 400 feet; 5 per cent. from 400 to 500 feet; 5 per cent. from 500 to 700 feet.

A comparative study has recently been made of the chemical composition of these various seams to develop any points of difference or similarity that may exist. Ten representative mines were selected for each seam and samples taken from car lots of screened nut or lump, as made ready for the market. The average for each lot of 10 was computed with results as shown in Table I.

TABLE I.—*Proximate Analysis of Air-Dry Samples by Geological Seams.*

Constituents.	I.	II.	V.	VI.	VII.
Fixed carbon	46.10	47.92	42.87	44.72	49.90
Volatile matter	37.31	37.31	38.96	37.67	36.3
Ash	8.97	6.45	9.98	9 01	7.29
Moisture	7.56	8.32	8.19	8.60	6.38
Combustible (ash and water free)	83.47	85.23	81 83	82.39	86.33
Total carbon	71.91	72.63	69.39	68.75	73.90
Sulphur	2.17	2.28	2.61	2.75	2.22
B.T.U. per pound of coal	12,134	12,243	11,851	11,571	12,397

It will be seen from the table that the coals of the State vary within rather narrow limits. In point of total carbon and heat units, seam No. 7 would rank first, being closely followed by seams No. 2 and No. 1. Seams No. 5 and 6, which yield 69 per cent. of the total output, come last. It should be noted, however, that the difference between the highest and the lowest is only 7 per cent. of the latter. The order given above has been determined by the factors for total carbon and the thermal units. It is interesting to note, however, that the figures for sulphur indicate the same order, with the exception that seams No. 2 and 1 exchange places. Grading the seams by their ash content, No. 2 would be first with No. 7 as second, while No. 5 and 6 would exchange places. But these differences are somewhat finely drawn and may be of scientific rather than practical interest.

There is one phase of the matter that may bear further discussion. Illinois coals are of a type midway between the semi-bituminous coals of the East and the lignitic coals of the Northwest and Southwest. Perhaps the most striking characteristic of each type lies in the composition of the volatile matter. Too little attention has been given to this constituent. A misleading label for it has come into general use, viz., "volatile combustible," whereas a very considerable percentage is inert and non-combustible. This factor representing the amount of non-burning combustible matter has been worked out for a large number of Illinois coals, and in the case of the averages by seams from Table I., the results are shown in tabular form as follows, as percentage of air-dry coal:

TABLE II.—*By Geological Seams.*

Constituents.	I.	II.	V.	VI.	VII.
Total volatile matter	37.31	37.31	38.96	37.67	36.43
Actual combustible vol. matter	25.75	24.71	26.52	24.03	24.00
Non-burning volatile matter	11.56	12.60	12.44	13.64	12.43
Total actual combustible (fixed carbon + true volatile combus.)	71.91	72.63	69.39	68.75	73.90
So-called combustible, *i. e.*, ash and water free	83.47	85.23	81.83	82.39	86.33
Ash and water	16.53	14.77	18.17	17.61	13.67
Ash, water and non-burning vol.	28 09	27.37	30.60	31.25	26.10

A comparative summary, therefore, would be as follows: In semi-bituminous (Pocahontas) coal, one-fourth of the volatile matter is non-combustible; in Illinois coals one-third of the volatile matter is non-combustible; in lignite one-half of the volatile matter is non-combustible.

Even more striking, perhaps, is the ratio of non-combustible volatile matter when referred to the total coal content. In Pocahontas coal 4 per cent. is volatile non-combustible; in Illinois coal, 12 per cent.; in lignite, 20 per cent.

Now take the usual practice of the engineer in referring for example the evaporative efficiency of a boiler to the "combustible," *i. e.*, to the "ash and water free" condition, whereas in truth the actual fuel is the "ash and water free" minus also this additional factor from the volatile matter which is non-combustible. In the case of Pocahontas coal the difference is slight and the error small, and although 25 per cent. of the volatile matter is non-combustible the entire amount of volatile is only 16 per cent. to 20 per cent. of the coal, hence the 4 per cent. or 5 per cent. of error resulting from this method of reckoning is not so great. By the usual method the engineer would calculate that 105 pounds of Pocahontas coal would make 100 pounds of "combustible" as "ash and water free." As an actual fact, were the calculation based on the material present which burns, it would require more nearly 110 pounds to make 100 pounds of this true combustible. Now, when we consider Illinois coals on this basis, the common calculation would show approximately 120 pounds of coal as containing 100 pounds of "combustible" as "ash and water free," whereas 100 pounds of actual combustible present would require more nearly 140 pounds of coal.

When we come to lignites the difference is still more striking. The common method of calculation would call for 120 pounds to yield 100 pounds of "combustible," whereas, in fact, 160 pounds are needed for each 100 pounds of real fuel. These facts may be more readily shown by means of Table III. made up from averages of typical samples.

TABLE III.

Kind of Coal.	No. of Pounds Ordinary Coal Required to Make 1 0 Pounds of "Combustible." Common Method "Ash and Water Free."	No. of Pounds Ordinary Coal Required to Make 1 0 Pounds of "Combustible." Proposed Method Ash, Water and Non-Combustible Volatile Free.	Error of Common Method in Pounds per 100 of Actual Combustible.
Pocahontas	104.62	109.43	4.81
Illinois	119.00	141 00	22.00
Lignite	120.23	162.49	42 26

These facts suggest a number of questions. In the first place, is it not true that the ordinary boiler test for determining evaporative efficiency has enough guesswork about it already without introducing this evident element of error.

Again, if the rating of a boiler using Pocahontas coal were referred to actual combustible and then the same basis were used when working with a coal of the Illinois type, it would be known at least that the difference in results could not be explained by the fact that the two coals were fed into the furnace under different names. Can there be any scientific basis of comparison where there is no similarity in the initial units?

If the chemist had made this factor for the non-combustible portion of the volatile matter as easily accessible as the factors for ash and water, would the present anomalous practice have become established? On this purely chemical phase of the matter I may have something to say at another time.

Tendencies in the Foundry Industry.

By DR. RICHARD MOLDENKE, Watchung, N. J.

Apart from the revolution in the foundry from old-time customs there is manifest to-day a tendency toward refinement in method little dreamed of by the most ardent iconoclasts of a decade ago. Perhaps our peculiar situation in this country, where the foundry is engaged in pushing specialties to the limit, has enabled us to take the lead in many directions. On the other hand, we must deplore the lack of interest in—or, shall we say, lack of time for?—many things which if properly followed up would remedy many a difficulty with our cost accounts. For instance, while the adaptation of the moulding machine for production in quantity is sometimes truly marvelous, how little is known of it outside of the shops where this development has taken place. Again, how little is done by the producers of coke and pig iron to bring the ordinary classes of these materials up to the standard of what we now term "fancy" articles.

The importance of a thorough knowledge of the materials entering the foundry is becoming more manifest daily. I remember distinctly the adverse criticism a book on cast iron came in for at the time of its publication because it went into the production of coke and pig iron too extensively. To-day we see that it is good to know how these

processes are carried out, as we can more easily trace the causes of loss and difficulty in the foundry—conditions not realized by the makers of these materials, as they are not using them daily in the difficult art of making castings of the highest qualities for the lowest price. I might go further and say that the founder who is also thoroughly versed in the art of casting brass and bronze is more apt to be particular with the iron end of his concern and can overcome occasional metallurgical puzzles more easily.

The Tendency Towards Multiple Operations.—Perhaps the very first thing which strikes the European foundryman who is visiting our plants is the great stress laid upon system and organization in our strictly modern establishments. The European founder, with his more varied work of smaller aggregate tonnage, casts his pieces one by one and finishes each with the assembling following directly. We, with an eye to the finer economies, prefer to put through an order of anywhere from a dozen to thousands of pieces of a kind, finishing them up for stock and stealing the parts required for sales and promises. As the stock in the warehouse gets below a certain minimum another shop order goes in to fill up the gap. As a consequence the work is always produced at the cheapest rates possible. I have personally known single orders of 100,000 castings of some 30 pounds each given with simply a blue print of the casting attached to the document. Many times the quantity has been 30,000 to 60,000, which meant that economical work could be done here if anywhere. Actually the figures at which these castings were carried out would be astonishing.

Apart from the use of molding machines to turn out these classes of castings cheaply there is a noticeable tendency to economize shop room, and hence molds are piled as high as they can be conveniently poured.

It may be objected that this method oftentimes produces more sprues per pound of casting than the old way and that if trouble comes a stack of molds will be ruined instead of only a single one. Yet this system has been found to pay wherever tried and the getting of more tonnage for a given floor space is bound to spread. The idea, however, should be followed out to its logical end wherever work is made in sufficient quantity. This would seem to be the stacking up of the molds in fairly deep foundry pits, the iron being brought in large ladles by traveling crane and poured from the bottom of the ladle. Suitable variations in the method can naturally be devised for given cases, but the idea remains the same—to get the greatest tonnage for a given floor space in order to save investment and c st of output.

Sand Treatment Important.—Greater attention will ultimately be given the preparation of the molding sand. European shops are far ahead of us in this respect, every foundry of importance grinding its sand to a given standard, then passing it through mixers, which incidentally fill the perfectly uniform material with a maximum of air, thus cushioning the sand and keeping it open. When a highly refractory molding sand is used this treatment assists in turning out the smoothest kind of work. As our consumers are constantly harping on better looking work this point might be considered more carefully by American foundrymen. Many sands are exceedingly uniform in their natural state, as for instance the well-known Albany, the result being highly finished castings where the best molding methods are employed. On the other hand, who does not recognize a Pittsburgh casting—that is, one made in the sand dug in the environs of the Smoky City? Judicious sand treatment would go a great way to remedy the difficulty even there did they make the class of work current in the Eastern States. What great differences may exist in molding sand in the same heap may be seen in an exaggerated way where sand conveyors are in use. Here, unless special precautions are taken, the loamy particles in the sand may get together, leaving the silicious portions without a binder. The result is that copes drop out, scabs are formed and other troubles come. No wonder that in the ordinary tempering of sand an art is involved which must be acquired before a man can rate himself proficient in this branch of the work. Hence the effort to get away from imperfections in the make-up of the molding sand heaps by mechanical grinding and mixing. This has not struck our country very hard yet.

Attention may be called here to the marked disposition of manufacturers of foundry facings and other supplies of a like order to learn more of their own art. The foundry industry as a whole is bound to benefit by this and we wish the facing men all success.

We must not forget to mention the growing practice of performing as many operations about the foundry as possible by mechanical means. We have now some excellent examples of what may be done in this way in our advanced foundries. Whether it be the mechanical charging of the cupola the mold and sand conveyors, metal distribution, compressed air attachments or yard cranes, this movement is to be encouraged, as wherever the manual labor of several men can be replaced by the brains of only one conditions of management are much easier to meet. The investment may become higher, but competition can be better faced and the resources of the nation employed to the greatest advantage.

Standardizing Demanded.—There is a growing demand for foundry standards. Thus flasks, pattern work and the molding methods depending upon the close co-operation of the pattern shop with the molding floor are coming in for considerable attention. The makers of molding machines will be greatly benefited by this desired standardization of flasks, for the time has now gone by when a manufacturer would go out of his way to get the most impossible screw thread in order that the repairs subsequently necessary would have to come to him. We should undoubtedly see the day when all the designs of the drafting office of an industrial establishment will go for revision to its foundry superintendent in order to standardize the non-essential elements therein and create less labor in producing the castings.

In going through many a foundry where very large loam molds are made for stock work one cannot help regretting the tearing down of the mold which might be left standing if the subject of permanent molds had been studied more carefully by the foundry foreman. The effort to-day is to economize in every way possible and very often here is a chance to begin.

We owe much to our high-class custom pattern shops for the progress they have forced upon the pattern end of our industry. It is not so long ago that metal patterns were unheard of in many foundries. It seemed like a waste of good money to put more time and effort on a pattern than was required by the ordinary article we all have piled on our pattern shelves. However, many a shop to-day can boast of a set of metal cutting machines which remind one of a first-class tool room. This tendency is, however, closely interwoven with the specialization of the foundry, and where a first-class man is in charge the pattern storage soon becomes less of a graveyard for obsolete material.

We can also note a marked tendency toward more substantial buildings. Wood is becoming dearer. Fires are more disastrous to the business than to the shop itself. Hence greater precautions to prevent shutting down when least able to stand it. Whether foundrymen are becoming richer or are more progressive is hard to say, but the number of new buildings going up to replace worn out and tumble down shacks is very gratifying.

Greater Use of Steel Scrap.—Turning now to the melting and the closely allied laboratory we see that the most strongly marked feature is the production of higher grade castings by the addition of steel scrap—or, in other words, the reduction of the total carbon in cast iron, making the crystalline structure more closely adherent and hence the whole casting stronger. Here the skill of the melter is joined with that of the chemist so that value is received from the higher priced stock charged into the cupola. The cupola process is being studied more carefully and experts in that line can produce results close to those of the air furnace or open hearth. Considering that this is accomplished with fuel and metal in contact and by a notoriously unsatisfactory melting method, which the cupola process undoubtedly is from the standpoint of the treatment the metal gets in it, the foundry industry is to be congratulated upon its ability to retain a strong hold on the making of castings in the face of the hard knocks it is getting from the steel casting establishments. This movement toward better grades of metal is but in its infancy. The cupola, which is a cheap melter, will undoubtedly be improved with the view of getting better results from the steel scrap additions. The metal will be safeguarded more from burning and the additions of the scrap will be systematized more, so that a given quantity will produce given results more regularly than is now the case.

The tendency above mentioned has somewhat retarded the introduction of air furnaces in general foundry practice. However, taking into consideration the demand for better irons, better coke, better melting methods, the specialist founder will soon tire of buying high-class material and spoiling it or taking big chances in that direction. He will naturally revert to the air furnace as better able to give high-class results from high-class material and the consumer will be glad to pay the difference.

Conservative Prices for Castings.—Those who have taken the trouble to follow the silver and copper market will have noted that the high levels reached are not due to spasmodic fluctuation made by financial manipulation but are the result of a real ability on the part of the civilized world to absorb these metals. We have the same thing in the iron market. The swing of the pendulum from the 22,000,000-ton

mark will soon carry the consumption of the metal far into the 30 or 40 millions, and unless the country can produce this quantity steadily the price is bound to rise sharply. To-day we find few men in our line of work who are out for abnormally high prices for their product. We all wish for nothing better than a fair profit on base purchase prices, which are fair to the furnace and coke dealer as well as to us. Hence the output of our establishments will be kept as much as possible within conservative price limits and the quantity will be made to increase gradually. It may be said, however, that the resources of the country will not be able to respond quite as fast as the demands the rapidly increasing population is making upon them, and hence we will never see the days of 1894 prices again, for which let us be thankful. All this means that with better prices, even if pig iron and coke hold well up, a more liberal tendency in the way of investment is bound to manifest itself and everybody will be the gainer.

Whereas once the melting point of the various cast irons formed the one absorbing topic for articles and discussion, at present it is the elimination of sulphur in the cupola. This is a good sign, and even if one man finds that he cannot get the results of the other, and therefore we are at present quite at sea regarding a desirable method, yet it shows a tendency and a good one.

With more light on this question it is but a step to work on others and finally we may get down to a closer study of the burning effects manifested in cupola and air furnace practice, which I hold are the most important by far of all the phenomena of the foundry melting processes, granted that the chemical composition is otherwise correct.

The Use of Ferro Alloys.—This leads us to the use of the ferro alloys in the foundry to correct the evils we know and others we have a vague apprehension of. To-day the use of ferromanganese and of aluminum is quite extended and is really a help in many instances. With the poor pig iron and especially the very poor coke the smaller founder is forced to put up with, the use of either of the above mentioned correctives is to be recommended. Unfortunately ferromanganese is hardly powerful enough to do much good in the foundry unless the mixture has a goodly proportion of steel in it. When this is the case it means a higher melting point, and with higher temperatures than ordinary cast iron is apt to be poured at much of the oxidation is removed and we avoid the pin holes and other weakening and unsightly effects which seem to be somewhat the rule at the present day. The real foundry alloy, however, is still to be discovered and made commercially and its day cannot come to soon.

I look forward to great improvements in the making of producer gas. We hear of mysterious developments across the water by which a more powerful heating agent is secured. How far the reports are true we cannot say, but that work is being done in that direction is certain. It may mean a cheaper and more powerful fuel gas, and if so it has a good place in the modern foundry, for whoever has worked with gas instead of coal will stick to the former until the price soars out of sight. Whether we are to have the open hearth furnace in the big foundries or the making of electricity with the gas engine in the smaller foundries for use in melting, time will determine; but it is well to keep this development before us and to profit thereby.

The Electric Furnace for the Foundry.—This brings us to the consideration of another matter. The Canadian Government is doing much to foster the development of electric smelting. The makers of the latest types of electric furnaces are constantly getting better efficiencies. Now with a cheap gas in a gas engine and for the making of very small castings in small quantity there is no reason why the small steel and bronze foundries should not melt their stock in the electric furnace. The higher price of the work sold will probably stand this. This matter will bear watching. I have recently noticed the suggestion of Dr. Waldo of New York for the making of Bessemer steel rings of suitably shaped small ignots, these to be of the composition of the steel casting. Now by charging these small ingots into the electric furnace one obtains a fluid steel of the proper composition to cast. I would suggest as an improvement that the ignots be preheated up to the highest point possible without injury to the metal—say, just as the ingots for rails or structural steel are treated. This would leave for the more expensive electric current only the finishing heat necessary to melt and superheat to the point right for pouring.

The considerations presented above will show our foundrymen that we are by no means through with the improvement of our processes, and were it possible to enlist an active encouragement on the part of the industry many of these very direct problems could be attacked and possibly solved.

The Direct Metal Process.—Finally we come to the general problems of the foundry, in which there are also marked signs of a change. This will probably affect only the very large industries for the present and next generation, but what may come after is very hard to say. Foremost stands the rapidly increasing use of direct metal. This is more marked across the water, but is bound to come here also. The big segments for the tunnel shields and linings should never have been made of remelted metal. However, this does not mean that it was advisable from the first to jump into a new method for such vast contracts. Here again we strike the importance of the use of steel scrap in gray iron castings in order to reduce the total carbon. I would not advocate the use of direct metal just as it is, but to have the stream of metal from the blast furnace go into large heated mixers, which means greater—in fact, more easily attained—uniformity than is ever possible with the cupola. Now into this mixer there should be charged successively quantities of steel scrap which have been heated up almost to melting. This accomplishes a twofold purpose. First, it gives a reduction of total carbon without lowering the temperature of the metal in the mixer too seriously to be corrected at once by the heating method used as well as the comparatively large quantity of metal that should be in the mixer all the time. Now, the first result is the making of a high grade of cast iron. This iron should be good enough for all the purposes the process could be used for, such as the making of pipe, tunnel segments, ingot molds, etc.

The second effect of the addition of the preheated steel scrap is that the problem of kish is done away with. This is the bugbear of the direct metal foundry, and in fact has retarded the introduction of direct metal for important work so much that at one time it was thought out of the question to think of ever going back to this ancient way of making castings.

What, then, will be the result of this tendency? It means that blast furnaces will be located wherever the raw materials not only are favorable but where there is a good shipping point for pipe, possibly car wheels and not impossibly malleable castings for car work. The furnace proposition will then become one of allied industries to give an outlet for the pig iron made which will fit these uses, and all the pig iron not of composition to go into the various mixers will be put upon the market.

While this seems visionary, it is nevertheless a fact that one very large combination is about to break ground for just such an establishment and we may hear from direct metal pipe very soon. With our American enterprise one hesitates to say just where these changes in method of production as well as administration will end, and it is even within the range of possibilities to find stoves made at a blast furnace once the molding machine has conquered the field that is before it in that line.

It remains for the men at the very top of our great industrial establishments to solve the fine points in producing enormous quantities of high grade castings and to make them cheaply. These men are to be found in our foundrymen's associations, in our great engineering societies and wherever the active individuals of our industry get together to discuss questions of practice. I venture to say that without our progressive institutions of this kind the entire foundry industry would be what it still is in some of our large cities where the pig iron salesman makes the mixture and the ignorance of the customer makes the price.

Electrolysis by Alternating Currents.

Whether or not electrolysis by alternating currents will prove of any technical value, it would be premature to say. As early as 1879 Berthelot obtained certain organic oxidation and reduction effects by these means. Some years ago Richards and Röpper proposed to prepare cadmium sulphide—a yellow coloring material—by sending alternating currents through two cadmium electrodes dipping into a solution of sodium thiosulphate. That process did not answer, and could hardly answer if carried out as proposed. On the other hand, Brochet and Petit have succeeded in preparing the platino cyanide of barium, for which the study of electric radiations has created so great a demand, with the aid of alternating currents, passing through two platinum strips immersed in a solution of barium carbonate in hydrocyanic acid. Theoretically, in any case, electrolysis by means of alternating currents is a most interesting and promising field of research. Kelvin, Kohlrausch, and many prominent scientists have worked in it. In how far the field is promising, we see at once from the investigations of Max Le Blanc and Schick, of Karlsruhe.

Under ordinary circumstances, we might think, there should be no such thing as alternating current electrolysis. For the metal which

the anodic current impulse dissolves should be precipitated again by the next cathodic impulse, and the solution remain unchanged. This is in a certain measure correct for symmetric currents in which both impulses are of the same duration and identical, apart from the direction. But polarization, current density, temperature, diffusion, chemical affinities, and solubilities complicate the problems so much that the effects cannot be predicted. In spite of all these difficulties, Le Blanc and Schick have found in such experiments a way by which the velocity of certain reactions may be studied. Copper cannot be precipitated from its solution in potassium cyanide by continuous currents because, we assume, the copper forms complexions in this solution. The formation of these ions must take a certain, though very small, time. If we apply asymmetrical alternating currents of high frequency, we may succeed in changing the current direction before the copper ions have had time to enter into complex combinations, and thus we may stop the further solution of copper by the cyanide.

As a matter of fact, Le Blanc finds that while, with 1,000 current alternations per minute, the dissolution of the copper proceeds quantitatively as with continuous currents, it becomes less with higher frequency, and has diminished to one-third of its original value when 38,000 alterations are applied. This may be interpreted to mean that the reaction between the copper ions and the cyanide solution was quite complete at the end of $\frac{1}{1000}$ of a minute, but incomplete in $\frac{1}{38000}$ of a minute, and had not begun—if certain extrapolations may be relied upon—after the expiration of the first $\frac{1}{38000}$ of a minute. We presume in this argument that the formation of the ions themselves is instantaneous.

We have presupposed in these cases that the current impulses were asymmetrical. This is often essential, as we pointed out, and in some of the experiments the one impulse lasted three times as long as the other, so that the one electrode was essentially the anode, and the other the cathode. Under these conditions the one electrode—both of the same metal, copper—becomes lighter, because some of its copper is dissolved off; the other heavier, because copper ions are precipitated on it before entering into complex ions. Expressed in voltameter percentages, the anode loss by weight rose from 50 to 52, and the cathode gain decreased from 50 to 48 per cent., for instance; at high frequencies, with conditions of perfect symmetry, both figures would have been 50. When, however, the electrodes were strongly heated and quenched in alcohol, so as to offer an amorphous instead of a crystalline surface, the copper passed into a kind of passive or noble state, and too little copper was dissolved, while the deposition proceeded unchecked; hence the cathode gain was represented by figures like 55 and even 68, and the anode loss was 46 and 42. This noble copper shows a difference of potential against the ordinary crystalline copper. The passivity disappears under the influence of symmetrical alternating currents. Le Blanc regards the state of passivity, which many metals assume to a greater or lesser degree, as an indication of different degrees of reaction velocity in the transition from the metallic into the ionic state.

We have mentioned the researches of Brochet and Petit. They also worked chiefly in solutions of potassium cyanides, and found that different metals behave very differently. While certain metals were more readily dissolved by alternating currents when the frequency was raised, others passed through a maximum, and were less attacked at the highest frequencies. The solubility of the resulting cyano compounds, no doubt, has a considerable influence, and we do not wonder that nickel and iron should have shown marked peculiarities. According to Le Blanc, the second cathodic current impulse should liberate hydrogen, if the iron has meanwhile entered into a complex combination. Brochet observed a peculiar hydrogen evolution in the case of platinum in cyanide solutions, but he rejects Le Blanc's hypotheses altogether.

In order to be sure that he is dealing with alternating current impulses lasting for definite periods, Le Blanc has been using a commutator, although aware of the objections to any such mechanical device. He is now constructing an improved apparatus which is to give 25,000 alternations per second, not per minute. Many other experimenters use ordinary alternating currents, relying upon the fact that the current, if not asymmetrical to start with, will become so, owing to polarization and phase lag.

Mengarini, one of the first who studied the problems in more recent years—1891—arrived at the conclusion that as regards coulombs per second, the decomposition by alternating currents will always be less than with continuous currents, and that the current density must not sink below certain values, depending upon the electrodes, electrolyte, etc., and the frequency must not exceed certain figures, if there is to be any decomposition at all. He studied polarization in particular, recognizing its full importance, and stated that no decomposition would take place unless the cathode area was small enough to ensure a fully polarized condition being reached by the current impulse applied. Mengarini likened the effect of polarization to that of self-induction. Others saw more resemblance between the electrolytic cell and a capacity, but differed as to the question whether an electrolytic cell produces a phase difference.

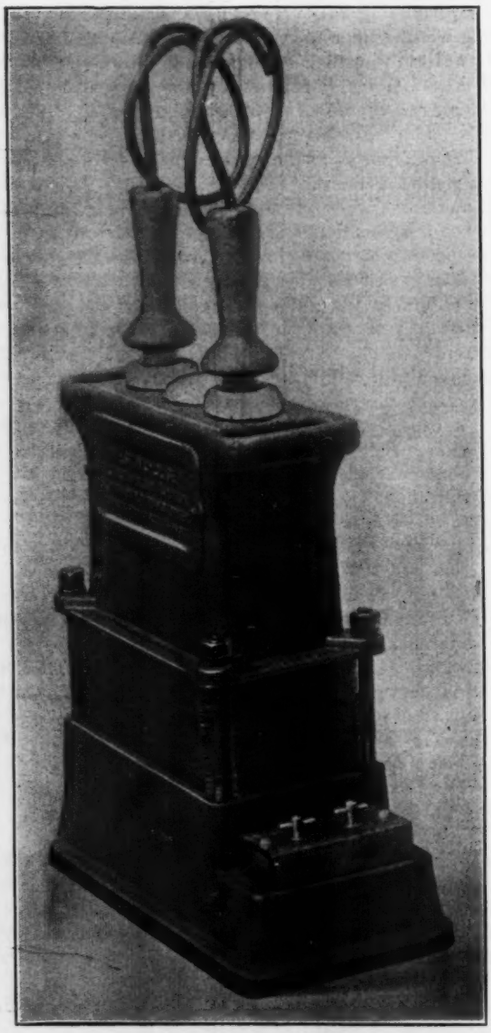
A great amount of work has been done on polarization; but the conditions are so complex that one hesitates to draw any general conclusions from the mass of detail. A brief communication which Mr. W. R. Cooper brought before the Faraday Society a few weeks ago clears up one point, and it is to be hoped that Mr. Cooper will resume this fruitful mode of research. He applied Deddell's oscillograph to alternating current electrolysis; he is probably not the first in this respect but he has given us a very good explanation of the nature of polarization. We might regard the polarization of a voltameter as of the nature of a capacity, represented by a condenser in series with a resistance, charged by a sine current, and then polarization should be in quarter phase with the current, provided the electrolytic resistance be small. But, though polarization may rise as rapidly as the potential difference to which it is due, it falls more slowly. While, therefore, the applied pressure has rapidly fallen to zero, the electromotive force of polarization will still be appreciable, and the voltameter therefore will act like a one sided and, moreover, leaky condenser, which refuses to discharge until forced by a reverse charge. The higher the applied potential difference, the greater will be the leakage; when the back electromotive force can rise no further, visible decomposition will set in. The sine curve therefore becomes distorted, and we have the asymmetry above spoken of. Mr. Cooper exhibited some very instructive pressure and current curves, taken with the oscillograph during the electrolysis of dilute sulphuric acid by wire elrctrodes and currents of frequency 83 per second. The looked-for shape of the current curve and the phase difference came out quite distinctly; but with higher potentials the phenomena became complicated.

The investigations of Professor Earnest Wilson, which the Faraday Society discussed on the same evening, follow another interesting, but, we venture to think, rather premature line, considering the complexity of the conditions which he himself emphasizes. Professor Wilson plots the applied coulombs against the electromotive forces, and obtains a kind a of hysteresis diagram, marking the energy absorbed for electrolysis work. As the frequency rises, the inclosed area of this curve diminishes; this holds good for the electrolysis of sulphuric acid with platinum electrodes, and for the electrolysis of the same acid and of various salts by means of electrodes of aluminum, lead, copper, zinc and iron. As a rule the amount of metal dissolved diminishes as the frequency rises.

The behavior of platinum electrodes in particular has occupied many investigators. Continuous currents do not dissolve platinum; alternating currents dissolve it according to some investigators, and only tend to weaken its cohesion according to Margules, Ruer, and others. Brochet and Petit believe that the frequency does not matter in the case of platinum electrodes when in cyanide solutions. They maintain that neither direct nor alternating currents will alone dissolve platinum in dilute acids, but that combined direct and alternating currents will do so. The chief condition is, in their opinion, that the current strength should fluctuate; interrupted direct currents should hence also have powerful solvent effects. All these are laboratory experiments, however. In their attempts to utilize waste alternating currents for the electrolysis of water, Van Name and Gräfenberg observed that all electrodes, including platinum, iridium, and gold, would corrode in dilute sulphuric acid, and that iron, nickel copper and silver did not any better resist the action of dilute alkalies if continued for longer periods. The electrode difficulty would certainly be great in commercial alternating current electrolysis.

A New Outfit for Electrically Thawing Water Pipe.

The *Metal Worker* notes that the winters of 1903–4 and 1904–5 were so remarkably severe that instances of frozen water mains and pipes became so frequent that the ingenuity of municipal departments intrusted with the care of this public utility was taxed to the utmost. The electrical method of thawing water pipes that had already been shown to be a practical thing was given widespread attention and in many cities the street railway and electric lighting companies entered energetically into the business of pipe thawing. The apparatus first employed for this work was more or less rough and ready, and comprised wagons for hauling around the city the men required to do the work and the electrical wires and instruments for tapping electric mains and regulating or controlling the amount of current to be passed through the pipes



Electric Water Thawing Outfit.

affected. Later the business grew to those proportions and elicited the interest of manufacturers of electrical machinery to that extent that controlling instruments and pipe thawing outfits were brought out specially for this work.

In brief the method consisted in tapping the electric mains, in running one of the wires to a faucet in the building affected and running the other to, say, a hydrant outside the building. The object was to provide for a flow of current from the mains through the portion of the piping stopped up. The work required no excavation nor tearing up of the piping work, but simply attaching the wires to the most convenient ends of the piping system that had become frozen. As there is no way of telling in advance exactly how much current will flow through the length of piping system so connected under the conditions of pressure or voltage obtainable from the electric system, it is necessary to have some controlling apparatus in order to prevent too much current being passed through the piping. For this work the alternating current lends itself particularly well, as the voltage, and consequently the current, can be readily regulated by means of the alternating current transformer.

The Westinghouse Electric and Manufacturing Company has recently placed on the market two outfits for pipe thawing work, one for heavy service and the other for lighter service. The latter consists of a transformer to which the wires from the electric mains are brought and from which another set of secondary wires are taken to the pipes. This transformer is arranged for adjusting the voltage or pressure of these secondary wires. As shown in the accompanying reproduction of a photograph it is compactly built and is inclosed in a case with cast iron top and bottom with the central portion of laminations exposed to the air to provide best conditions for cooling. Handles are provided on the top casting to enable one man to carry the transformer, its weight complete being approximately 100 pounds. It is intended for use on 2,200-volt alternating current circuits and has a variation in secondary voltage from 55 to 35 to maintain a current of 100 amperes for half an hour without undue heating.

In operation the makers advise that the transformer be placed as near the pipes to be thawed as possible. For dwellings one low tension wire may be connected to the faucet and the other to a hydrant so as to inclose the frozen section. For thawing street hydrants, two hydrants may be conveniently used. On account of the different conditions met with it is impossible to prescribe the exact current or voltage necessary to do any particular thawing. In general the voltage necessary to force the same amount of current through pipes of the same diameter will vary with the length of pipe. Large pipes require less voltage to force the same current through a given length but require more current to thaw them. For pipes up to 5 inches in diameter approximately 500 amperes of current is usually sufficient while 12-inch mains may require 1,000 amperes. As a rule, a small current for a long period of time will do the work that a large current will in a shorter time and the thawing is done with less chance of injury to the piping system. Last winter the Montreal Light, Heat and Power Company found 2 or 3 minutes sufficient for thawing service pipes ¾ inch diameter and 200 feet long. In some instances only 15 seconds were required for restoring the water supply and in a single day as many as 40 cases were successfully attended to. Again, in these columns on December 31, 1904, an instance was cited where a 1-inch pipe 250 feet long required 20 minutes with 50 volts pressure and 500 amperes of current; a 10-inch pipe 800 feet long required 2 hours with 70 volts pressure and 400 amperes current.

Oil Conditions in California.

The situation that confronts the oil operators of California at the beginning of the New Year is not, to say the least, very encouraging. In the Kern River field, the largest in the State, and the one which produces nearly half of the entire State production, the producer is entirely in the hands and at the mercy of the combined interests of the Standard Oil Company, the Southern Pacific Railroad (which is the largest consumer of oil on the Coast, consuming about 10,000,000 barrels yearly out of an entire consumption of the State), and the Associated Oil Company, which is now generally regarded by California oil men to be merely a subsidiary Company and an offshoot of the Southern Pacific Railroad, with the consent and approval of the Standard Oil Company. No independent producer in the Kern River field can sell the Southern Pacific Railroad a barrel of oil at any price, nor can they secure cars to ship their oil in as they desire, provided they are fortunate enough to capture outside contracts.

But on the other hand, the Associated Oil Company appears able to secure any amount of cars from the railroad to ship its oil in, while all the oil used by the Southern Pacific Railroad and likewise the Sante Fe is bought through the Associated Oil Company and the price paid is higher than other companies have offered the same oil for. One instance is known where a McKittrick oil company, whose lease had about expired, with a large quantity of oil on hand and no market for it, offered to sell the Southern Pacific Company 100,000 barrels of fuel oil at the price of 10 cents per barrel. This offer was refused, the reason being given that all oil used by the Southern Pacific was contracted for to be furnished by the Associated Oil Company.

Numerous instances have been known in the Kern River field where producers had made contracts with consumers of fuel oil, at good prices, but on account of the failure of the railroad to furnish cars, they were unable to fulfil the terms of the contract, and the consumer was forced to buy his oil from the Associated Oil Company.

In the Coalinga field, which produces about one-fourth of the entire State production, much the same conditions prevail as in the Kern River field. During the last few months the producers of that district have been agitating the project to build an independent producers' pipe line from the field to tidewater and enter the San Francisco markets themselves. The Pacific Oil and Transportation pipe line from Coalinga to Monterey proved such a successful and profitable investment to the owners and promoters that it was finally sold to the Associated Oil Company at a profit of from 100 to 300 per cent. on the original investment. When this deal was consummated it left the entire transportation facilities of the Coalinga field in the hands of the Southern Pacific and Associated Oil Company.

The Coalinga field has had the advantage of other inland fields, like Kern River, McKittrick, Sunset and Midway, in having the Mattson line, as the Pacific Oil and Transportation Company's line is called, and also the Standard Oil Company's line from Coalinga to Point Richmond in addition to the railroad for transporting their oil. During

the last year the Standard Oil Company has used its line almost exclusively for pumping oil from Coalinga and the line from Bakersfield to the junction with the Coalinga branch has been idle most of the year. This has left the Kern River field with no transportation except by rail. With the beginning of the year the line from Bakersfield has been started up, and the Standard has bought some small lots of oil from producers in the Kern River field. The Standard Oil Company has contracts with different producers in the field aggregating about 9,000 barrels daily, the greatest portion of which has been stored in the Standard reservoirs, making the entire storage in the field about 12,000,000 barrels, or less than 6 months' consumption. The entire field stocks in the State are about 15,000,000 barrels, while the consumption for the last year was 28,263,000 barrels. This situation makes the producers feel that the conditions throughout the State must improve within the next year, but the absolute control of the markets and transportation lines by a combination of interests puts the producers of the State at the mercy of this combination.

In the Santa Maria field, in the western part of the State and nearer to tidewater, the conditions are not so bad; but there, as in other parts of the State, the need is felt of being less dependent on a single buyer. and the low prices quoted (20 cents and 22½ cents per barrel) make gushers necessary to afford any profit, when the cost of operations is considered. The producing depth there is from 3,000 to 3,600 feet, it takes from 6 to 18 months to complete a well, and the cost will average from $15,000 to $25,000.

In the Coalinga field the present prices for crude are as follows: From 22 gravity up to but not including 24 gravity, 20 cents per barrel; between 24 and 25 gravity, 22½ cents; 25 gravity and lighter, 25 cents. In the Santa Maria field, for oil of 24 gravity up to but not including 25 gravity, the price is 20 cents; for 25 gravity or lighter, 22½ cents. For the product of the Kern River field (14 gravity or lighter) the price is 15 cents.

California's record for oil production and consumption during the past year is believed to be summed up with approximate correctness as follows:

District.	Barrels Produced. 1905.	Barrels Shipped. 19 5	Stocks. Dec. 31, 1905.
Fullerton and Brea Canyon	1,750,000	1,650,000	100,000
Puenta and Whittier	960,000	800,000	160,000
Los Angeles and Salt Lake	3,000,000	2,650,000	350,000
Newhall	150,000	150,000	50,000
Ventura	350,000	325,000	50,000
Summerland	75,000	75,000	....
Santa Maria and Lompoc	5,300,000	3,990,000	1,310,000
Kern River	14,000,000	9,500,000	12,000,000
Sunset	400,000	300,000	100,000
Midway	75,000	....	75,000
McKittrick	720,000	600,000	120,000
Coalinga	8,300,000	8,200,000	100,000
Sargents	20,000	20,000	....
Arroyo Grande	5,000	...	5,000
Half Moon Bay	3,000	3,0000	....
Totals	35,108,000	28,263,000	14,430,000

Number of producing wells at the close of the year, 2,014; number of wells drilling, 108; new derricks, 53. Of the producing wells 680 are credited to Kern River; 300 to Los Angeles and Salt Lake; 246 to Ventura; 168 to Coalinga and 73 to Santa Maria and Lompoc, with the rest distributed in smaller numbers through the other districts named. In the number of wells drilling the list is headed by Santa Maria and Lompoc with 42.

Reference was made in the *Petroleum Gazette* a couple of months since of the formation in London, England, of a Company to be known as the California Petroleum Refineries, Ltd., to operate in this State, the production for the initial business of the Company to be furnished from the property developed by the Graciosa Oil Company in Santa Barbara county. Reports from London give some details of the statutory meeting of the Company, held the 22d of last month. In the course of his remarks Chairman Griffith is quoted as saying:

"The starting of a company like this necessitates a great deal of time and trouble, the more so as the company is situated some 7,000 miles away in San Francisco. In order to facilitate business we named another Director, Mr. Crocker, who is one of our largest shareholders resident in San Francisco, and also Mr. Isaac Liebes, who is resident there, too. We have named these two gentlemen to be an advisory committee with power to act as directors there. They are at present occupied in choosing from different options the site on which to build the refinery, and they are hard at work at specifications and letting out the contract for such an establishment. The supply of oil, I may tell you, which we should obtain from the Graciosa Oil Company, is certainly much more than we shall be able, at least for a long time, to utilize. I may add that we have engaged as our engineer there Dr. Gurgeniaz, a man who has been highly recommended to us by one of our directors who is in the petroleum trade, Mr. McGarvey, who regrets he cannot be present to-day. Dr. Gurgeniaz, who has been highly recommended, has been employed in the refining of petroleum in the Caucasus, in Borneo and in many other parts. We do not doubt that we have found the right man in him. If there are any details as to what has happened on which you desire information, I will call Mr. Hay, our Managing Director, who has been out in San Francisco, and returned only two days ago."

Mr. Hay responded by giving the chief details of his trip to California in October last, reporting in part as follows:

"While out there I proceeded with Mr. Liebes, and again with Dr. Gurgeniaz, to visit several places on the Coast where sites for the refinery had been looked at. We eventually chose two or three in sequence as being all suitable, taking the various facilities we have to consider of transport by land and water and other matters into consideration. I hope to hear in the course of a day or two that we have been successful in securing such a site that will enable us to put our refinery in the best position possible. The site chosen will be right on the Coast, as near as we can at present tell. Our oil will be piped direct from the oil fields right into our tanks at the refinery, which is a very great consideration in the saving of a lot of products, etc., and will, I think, prove very advantageous.

"I visited, at the request of the directors, the oil fields, and took certain samples of the oil which was coming from the wells, and I think I may safely say, not only from what I saw myself but from what I heard from various people connected with the oil trade, that we need have no fear in the future as to a good supply of oil for our refinery. The present production of the wells is said to be—I did not see it measured, of course—about 11,000 barrels per day if the wells were flowing at their capacity. They are all flowing wells, none of them pumping wells. The oil is of very good refining quality. Our refinery manager is very well satisfied with it, and it has been used, I may say, in other refineries to considerable advantage The sale of our products, I think, will be also satisfactory there. A very large amount of gasoline is now being used in San Francisco and neighborhood; in fact, the demand is in excess of the supply at the present moment. All the little boats and steamers running up and down San Francisco bay use gasoline, and if they can get more of it, more boats, I suppose, will be wanting to use it. With regard to the fuel oil, there are at the present moment about 150 steamers plying both locally and to foreign ports using oil, and there is also a large demand for it, and especially when you take into consideration it is selling at a very much lower price than the actual cost of coal, there ought to be a big future for that fuel oil.

"It has been considered advisable to take a controlling interest in a refinery on San Francisco bay, so that we can learn more of the nature of the oils and products we might turn out. It will also be very useful in the building of our larger refinery, so that no mistake shall be made. This refinery, I hope, under Dr. Gurgeniaz's care, and with good management, will eventually prove of considerable use to us. I do not know that there is anything more that I can tell you with regard to my visit out there, except that I must say one or two words with regard to our local directors. We could not have anyone who were more anxious, more willing and more able to work for us than the gentlemen we have got there. I got every assistance from them; everything they could do for me they did, and all that they can do for the company they are doing. They have been negotiating all over the Coast with different people for disposal of our product and in getting all the information they possibly can.

"We have appointed as Manager Mr. Phillips. This gentleman is known very well to our Chairman, and I think you will join with me in saying that we could not have a better man than Mr. Phillips. He has got a thorough grasp of the business, and another thing is he is a believer in the company—he wishes to grow with it. He is a large shareholder, and I am quite sure that under his supervision we will be successful. We have all the elements of success, both in the oil fields and in our refinery, and I look forward to the future with a considerable amount of satisfaction."

Correcting the impression of a stockholder that the crude would be carried to the point of refining by water shipments, Mr. Hay explained that the first idea was to erect a refinery on the bay of San Francisco,

but since then it had been found that their oil, being of very good quality and having a valuable amount of products, might be deteriorated by the transmission by boats to San Francisco. There was also the double handling and, therefore, they thought it better that they should have the refinery as close as possible to the wells, and also where they could have a good shipping port for their products direct to wherever they might be disposed to send them.

Our Foreign Trade in Electrical Machinery.

By Mr. Henry L. Geissel, in *Elec. World.*

The exports of the United States, which never touched the billion-dollar mark until 1895, and had not until 1905 in any calendar year, been as much as a billion and a half dollars in value, exceeded that figure last year considerably, and approximated 1,600 million dollars. The total figures for the month of December are not yet at hand, and therefore the amounts given in the following account may be subject to slight corrections upon the final balancing of the statistical returns for the past year.

The expansion in our foreign commerce makes itself apparent in our trade relations with nearly all of the principal countries of the world, and the most gratifying feature of our export trade is the considerable increase in our exportation of manufactured goods. These exports exceeded those of 1904 by about $55,000,000. As close as it can be figured, manufacturers form over 38 per cent. of the total exports of domestic products. The total exports of electrical machinery last year exceeded $7,000,000, an increase of nearly $1,000,000 over the preceding year. This does not include electrical instruments of any kind, worth several millions.

In any city in any part of the world where the progressive steps of civilization demand the institution of economies and labor-saving devices, it is only a matter of time to find a means of obtaining money for their first cost. Telephones, electric lamps and railways are now being introduced into the remotest parts of the world. The demand for electricity is increasing the world over. The writer visited last year several countries on the northern coast of Africa and sixteen of the leading countries in Europe. He had made the same tour 3 years ago and was surprised to see the progress which had been made in the many different lines of electricity. Even in the south of Europe, in countries which are lamentably slow in the adoption of modern ideas, the electric current has made a wonderful showing of late.

In the town of Lund it is now proposed to utilize some of the waterfalls on the Laga river, not only for lighting Lund itself, but also for several other towns in the south of Sweden. During the negotiations made with the owners of these falls it was stated that a syndicate in Denmark would also make offers for the falls with a view to using them as a source of electric energy. The Laga river comes from the Smaaland uplands, runs for 3 miles through the Province of Halland, and has two large falls, the "Majefos" and "Catefos." This latter is about 1 mile from the river mouth and here the Danish syndicate proposes to erect power stations, the electricity being transmitted by cable to the coast of Helsingborg, and thence, by means of submarine cables, to Denmark.

Several strong companies and syndicates are now being organized in Stockholm; they are backed by Scandinavian and German capital, and their object is to harness all the streams of Sweden with a fall of water sufficient to generate electricity.

Our two best customers of electrical machinery last year were Canada and Japan, the former having bought nearly $2,000,000 worth—or about 35 per cent. of our total exports—and Japan over $1,000,000. The third place is occupied by Mexico, to which country we shipped electrical machinery to the value of $1,000,000.

In Europe, the United Kingdom leads the list with over $800,000. Then follow France, Germany, Italy, Holland, Russia, Scandinavia and Spain. Our total shipments of electrical machinery to Europe average in value $1,500,000; those to Central and South America, $500,000; to Asia, $1,400,000; to Africa, $150,000, and to Australia, $250,000.

Of the South American countries, Brazil and Argentina are our best customers. To the former we exported electrical machinery to the value of about $210,000, and to the latter $165,000. Smaller quantities went to Chile, Peru, Uruguay, Colombia, Venezuela, Ecuador and Bolivia. The total exports to Central America were valued at only $13,000, and those to the West Indies $88,000, of which nearly $85,000 worth was exported to Cuba. It is very much to be regretted that our trade with South America is so insignificant. Germany and the United Kingdom practically control the trade in electrical machinery in those countries.

But South America is not a negligible quantity by any means. It is, indeed, astonishing to see how the nations of Europe have outdistanced us of the United States right on our own western hemisphere. The large German electrical manufacturing companies have had for years their branches in almost every republic to the south of us. It was only recently that the Peruvian Government decided to install a great system of wireless telegraphy throughout the country, and the contract went to Berlin, the German house securing therewith the exclusive right of establishing wireless telegraphy within the boundaries of Peru.

Great strides ahead are also being made in the electrical industries of Brazil. The Rio de Janeiro Tramway, Lighting and Power Company, capitalized at $25,000,000, proposes the development of water power and the utilization of it in the form of electric energy in Rio de Janeiro and other cities. According to a recent report, the company has already acquired two large waterfalls, one on the Parahyba river, a distance of about 80 miles from Rio de Janeiro, capable of producing about 100,000 horse power; others on the Rio das Legas and streams in the vicinity about 50 miles from Rio de Janeiro, capable of producing 40,000-horse power. The latter plant the company is now developing and expects to have power from it in Rio de Janeiro within 6 months. It is estimated by the company that there is a present demand for 25,000-horse power. This, it is expected, will be considerably increased as the advantages of the use of electric power become fully demonstrated. The same company has acquired a number of suburban street car lines now operating with animal traction, the electrification of which will soon begin.

The greater part of the electric plant equipments and practically all the electric traction machinery used in Argentina are from the United States. Small electric motors and their fittings are also chiefly American, but the bulk of the electrical trade is still in the hands of European concerns. It is estimated that the total imports of electric materials in 1905 amounted to over $3,000,000, of which $1,000,000 worth came from Germany. The same proportions prevail in Chile and other South American countries.

It was stated previously that Japan is one of our largest customers of electrical machinery. Of our total exports to Asia of about $1,400,000 Japan received nearly $1,100,000, or nearly 80 per cent. The Japanese electrical industry centers around the city of Osaka, the seat of the great manufacturing industries of the Empire. The Japanese Government has appropriated large amounts for enlarging and repairing arsenals, shipbuilding yards, harbors, Government railway shops and general engineering works operated by the Government, and the demand for modern electrical machinery will, in all probability, continue to increase during the present year. Electricity has also been introduced to a large extent in the Japanese mining industries; the Hokkaido collieries, the famous Ashio copper mines and a number of other mining enterprises are equipped with large and up-to-date electric plants, the machinery being chiefly of American origin. In connection herewith it may be said that there is quite a brisk demand for electric motors to drive machinery in factories. The use of electric lighting is also spreading. In all probability the equipments of electric traction will be of considerable importance in the exports of American manufacturers to the Japanese market.

In China there is as yet little demand for electrical machinery, with the possible exception of telegraph equipments. Electric launches for use in navigating rivers and harbors might perhaps find a slight sale if properly pushed. Electric lighting plants are in use to some extent in the treaty ports. The use of electric power and traction machinery is confined to foreign establishments. The telegraphs and telephones, though sharing in the prejudice of the Chinese against all foreign innovations, have been adopted to a considerable extent. Not only foreign firms, but many Chinese merchants also, have their telephones, and several thousands of miles of telegraph lines have been built and others are projected.

The popularity of American electrical appliances and machinery in India, notwithstanding the protests made against their introduction by the British press, appears to be growing. It seems, however, that no serious efforts have been made on the part of American manufacturers to secure a firmer foothold in the Indian market. The same is the case in the Dutch East Indies, where German firms are doing considerable trade in electrical machinery and appliances.

More attention should also be paid to the South African markets. The city of Johannesburg is planning to spend millions of dollars for

improvements. An immense generating plant is now being installed there which will have one of the most extensive networks of conductors, the contract for which was awarded recently to a British firm. Some idea of the magnitude of this contract will be gathered from the fact that about 3,000 tons of cable and material will have been shipped from England before the completion of the undertaking is within sight. The present contract will amount to about $600,000 and it will include the furnishing of some 270 miles of cables for electric undertakings.

In conclusion it may be said that the problem of supplying electric power for industrial purposes is daily receiving more serious attention in most parts of the world. The demand for modern electrical machines and appliances is steadily increasing, and American manufacturers should spare no time or effort to secure a firmer and permanent footing in the various markets of the world.

The Behavior and Uses of Tars.

The *Gas World* notes that in a lecture before the German Association of Roofing Board Manufacturers, Herr Mallman, of Niederlahnstein, said that tars differ extremely in their behavior when distilled, but that this difference does not depend nearly as much as has been thought upon the percentage of water in them. Some tars with only 2 or 3 per cent. of water distil much worse than some other tars with as much as 8 or 10 per cent., and some with only 1 per cent. of water distil miserably and yield poor pitch. The difference lies in the percentage of carbon in the tar. If there be 25 to 30 per cent. instead of 10 to 15, the pitch contains 45 instead of 33 per cent. of carbon; it is matt on fracture, instead of glossy; it dissolves with difficulty in benzol, and the resultant lacquer gives a matt or dull instead of a glossy surface; it melts with difficulty instead of easily, and when melted it flows thick instead of thin; it does not mix readily with tar; it is always soft instead of glass hard. And in distillation the inferior tar burns out the retorts very rapidly. Even where the tar is not distilled, but only freed in open vessels from its moisture, coke will deposit and cause overheating and burning of the vessels employed. The pitch should always be obtained in the laboratory and examined; the percentage of it is no sufficient guide, for there are tars giving only 50 to 60 per cent. of pitch (about 23 per cent. of such tars), the pitch from which is bad, while there are some occasionally met with (about 13 per cent. of such tars) which may give as much as 70 or 80 per cent. of very good pitch, in which case the tar itself distils quite sweetly. Coke oven tar is more uniform than coal tar and makes good pitch (50 to 60 per cent.) though the other products are not as valuable.

The Uses of Tar on Roadways.—Dr. Ernst Burschell, of Landau-Pfalz, in an address to the Mid-Rhine Gas Association at their last meeting, gave a *resumé* of the work done in testing the use of tar for roadways and some additional data as to experiments made by himself. From these it would appear that the increase in the durability of the roadways will more than compensate the cost of applying tar to them. When the tar is applied, it sinks to a depth of 0.4 to 1.2 inch below the surface, and forms a waterproof coating which is tough and elastic. This property of tar—binding stone together—has attracted the attention of many inventors; and of their inventions one, that of Herr Dörr, Germersheim-am-Rhein, has been brought to a practical result, and a new building material, Dörrite, is being manufactured at the Dörrite works at Germersheim. The tar used is coal tar, and it is heated to 140° to 160° C. to get rid of water and light volatile oils. The stone used is Rhenish gravel, crushed fine and thoroughly dried. The tar and crushed gravel are both heated and at the same time thoroughly mixed in a revolving drum. The material is then transferred, in measured quantities, to hydraulic presses, in which it is exposed to a pressure of 2½ tons per square inch. Thereby it is given great strength and cohesion. The product which is in blocks or in slabs, contains 17 to 20 per cent. of tar and 80 to 83 per cent. of stone. It is very hard, tough and elastic. Recently special attention has been paid to the manufacture of slabs on account of the waterproof character of these, which fits them for use as paving stones and for flooring stables and cowhouses. For the latter purpose they are superior to cement in that they remain dry while they afford a warm footing, and as they always retain a rough surface animals do not slip on them. The same firm make paving slabs 4 inches thick, costing about $1 per square yard, made of tar and crushed basalt, of which some are in use in the streets of Stuttgart. These materials are unaffected by acids or alkalies and are, therefore, useful for the flooring of accumulator rooms and the like. There is no slipping upon them; and their wear and tear is very small.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At a recent meeting of the Town Trustees, Santa Clara, Cal., an ordinance was adopted fixing the selling rates for gas—the plant is operated on municipal account—as follows: To those using less than 25,000 cubic feet per month, $1.50 per 1,000; over 25,000 cubic feet and less than 100,000 cubic feet per month, $1.25 per 1,000; over 100,000 cubic feet, $1 per 1,000. Minimum monthly bill rendered, 50 cents. When the gas is ordered shut off the meter will be removed and a charge of $1 will be made for resetting it.

Mr. J. E. Hodgson, of Philadelphia, Pa., is now in full charge of the electrical department of the business of the Fulton County (N. Y.) Gas and Electric Company.

Mr. Edward I. Miller has been reappointed Deputy Commissioner of Water Supply, Gas and Electricity for the Borough of Richmond, N. Y.

The Massachusetts Board of Gas and Electric Light Commissioners has assented to the petition of the Springfield Gas Light Company for the right to issue $100,000 worth of new stock. The offering price is put at $200 per share.

"A. V. S.," writing from Lincoln, Neb, under date of the 11th inst., informs us that Councilman Hoppe reported at a late meeting of the City Council, he had received a report from C. L. Dean, instructor in mechanical engineering, the State University, on gas tests made during the months of November, December and the first week in January, the tests being in reference to the heating value of the gas supplied on the B. T. U. basis: Nov. 21, 523; Nov. 23, 538; Dec. 6, 593; Dec. 12, 592; Dec. 18, 639; Dec. 19, 614; Dec. 20, 593; Dec. 21, 612; Dec. 22, 624; Dec. 23, 612; Dec. 26, 600; Dec. 27, 589; Dec. 28, 596; Dec. 29, 594; Jan. 3, 598; Jan. 4, 578. The range of thermal values thus shown is 101 units—538, Nov. 23, and 639, Dec. 18. The Gas Company is not disposed to dispute a thermal standard of 600, but it will not consider as fair a standard in excess of that figure.

The contracts for building the plant and pipe lines for the Chester County Light and Fuel Company, of Chester County, Pa., have been awarded to the Philadelphia Gas Engineering Company, of Philadelphia, Pa. The main works will be located in Avondale, Chester County, and the pipe lines will be run to Kennett and West Grove, 3 miles each way.

The Green Fuel Economizer Company has installed an economizer in the plant of the Jackson (Miss.) Street Railroad, Light and Power Company.

Mr. E. H. Yorke, Engineer and Superintendent of the Portland (Me.) Gas Light Company, writing to us under date of the 13th inst., says:

To the Editors American Gas Light Journal: A recent experience of the writer with a stoppage in a gas main, which was so unusual and the first in his engineering career, suggested to him that an account of this stoppage might not only be interesting but perhaps of practical value to other gas men. The point at which the stoppage occurred was in a 12-inch main, about half a mile from the gas works. This main supplied the larger part of the gas to the commercial district, and although it had been in continuous use for over 40 years, no stoppage in it had been reported. The usual pressure of gas in the commercial district was maintained steadily up to the evening when we were first apprised of some trouble in this main, when it dropped 10-tenths of pressure. Owing to the fact that there were but few service connections in the immediate vicinity of the stoppage it was necessary for several successive days to excavate to the main. The morning of the day on which the stoppage was found we had reduced its location to within 2 points, about 20 feet apart. Observations as to the condition of the main at these two points furnished no information as to the cause of the stoppage, as there was no water in it, nor the slightest trace of naphthaline. The removal of a section of the main between these points brought to view the cause of all the trouble, which was as follows: When the main was originally laid, the spigot end of a length of pipe not having been forced up against the shoulder of the bell when the joint was yarned, the yarn was driven through until it formed a network over the entire area of the end of the pipe. This yarn served as a screen to arrest the naphthaline, and a deposit had

formed until it effected a complete stoppage. In view of the fact that during the past year we have not been troubled with naphthaline deposits in the service pipes this deposit of naphthaline in the 12-inch main appears all the more singular and furnishes another interesting object lesson of that arch enemy of the gas man—naphthaline.

AT the annual meeting of the San Diego (Cal.) Consolidated Gas and Electric Company, the Directors elected were: Fred. W. Jackson, H. M. Byllesby, J. G Mossin, D. F. Garrittson, R. C. Dawes, U. S. Grant, Jr., and R. G. Hunt.

A CORRESPONDENT in Salisbury, Md., writing under date of the 12th inst., says that the Salisbury City Council on the 8th inst., granted a franchise to the Salisbury Gas Company. The Company is capitalized in $75,000, and its Directors are: Daniel C. Spruance, of Smyrna, Del.; Joseph Marvel, Wilmington, Del.; and M. A. Humphreys, James F. Ellegood and W. S. Gordy, Jr., of Salisbury.

THE agreement between the Company and the authorities dictates that the Company shall pay to the town a rental of $150 per annum, and the authorities have a right to buy the plant at a valuation at the end of 50 years. The price of gas is fixed at $1 25 net (gross $1.50) per 1,000, until the output per annum reaches 10,000,000 cubic feet, then there is to be a concession of 5 cents per 1,000 for every additional 5,000,000 cubic feet sold per annum, until the rate of $1 per 1,000 is reached, which shall be the final rate.

MR. GEORGE H. CREED has been reappointed Deputy Commissioner of Water, Gas and Electricity for the borough of Flushing, N. Y.

MR. THOS. B. GUITTEAU has resigned the position of Auditor to the Toledo (O.) Gas, Electric and Heating Company, in order to assume the duties of Secretary to the various Masonic bodies in Toledo.

SOME days ago the Board of Public Service of Hamilton, O., which operates gas and electric plants on municipal account, issued notice to the effect that from the 1st prox. the following rates should prevail: On gas account; below 10,000 cubic feet per month, 80 cents per 1,000; between 10,000 and 100,000 cubic feet, 60 cents per 1,000; over 100,000 cubic feet, 50 cents. On electric account; less than 300,000 watts, 8 cents; over 300,000 watts, 6 cents; over 500,000 watts, 5 cents. It was resolved at the same meeting that no service would be rendered after the 1st prox. to those whose bills remained unpaid to such date.

WE were in error in stating last week that Mr. T. H. Laboyn had succeeded Mr. Schaddelee as Manager of the Albion (Mich.) Gas Light Company. Mr. Paul Ray, who was elected Vice-President and General Manager of the Albion Company in February, 1905, still remains in the named dual position.

A CALENDAR just to hand from the Davis & Farnum Mfg. Company, of Waltham, Mass., which holds a place of grace in the sanctum, is attracting much attention. The frontispiece is a reproduction of the original painting entitled "Adele," by Mr. Albert Lynch, of Paris, France.

MR. FRED. J. MAYER, of Messrs. Bartlett, Hayward & Co., of Baltimore, has returned home from a visit to Europe, mainly taken for the benefit of his health, arriving in New York the 13th inst., per steamship Amerika. With much satisfaction we report that his physical condition is greatly improved. He was accompanied by his wife.

AT the annual meeting of the Saratoga Springs (N. Y.) Gas, Electric Light and Power Company, the following officers were elected: President, Edgar T. Brackett; Vice-President, Eugene L. Ashley; Secretary, Elmer J. West; these and Messrs. H. C. Todd, C. E. Parsons and Walter Trumbull comprise the Board of Directors.

THE selling rate at Pomona, Cal., has been reduced to $1.25 per 1,000 cubic feet.

THE following notice, which carries its own story on its face, was issued some days ago: "The Electric Lighting Company, of Mobile, Ala., desires its many patrons, and the citizens of Mobile generally, to know that another reduction in gas rates has been made effective January 1, 1906: Illuminating gas at $1.70 per 1,000; cooking and heating gas, $1.30 per 1,000. The above rates are subject to a discount of 10 per cent., when payment is made at the Company's office on or before the 10th of the month following month of service. The above reduction is another proof of the policy of this Company in sharing with its customers the benefits to be derived from an enlarged consumption of its commodity. Get a gas range and only pay $1.17 net per 1,000 feet for gas consumed."

THE sum of $27,750 was paid to the authorities of Louisville, Ky., on the 10th inst., which sum represents the earnings of the city for the past 6 months on its ownership of $925,000 in the shares of the Louisville Gas Company. The dividend is at the rate of 6 per cent. per annum.

THE proprietors of the Lee County (Ills.) Lighting Company have been asked to put the selling rate all around at $1 per 1,000. Manager Higgins very properly objects to such a determinate cut, and the likelihood is that the rate will be $1.15 on net account.

THE proprietors of the San Diego (Cal.) Consolidated Gas and Electric Company have decided to put their mains into and through the Coronado district.

MR. GEORGE C. TURNER, will leave the service of the Ypsilanti (Mich.) Company, to take a position in Coldwater, the 1st prox. We understand that Mr. G. H. Hubbard, of Ann Arbor, will succeed Mr. Turner at Ypsilanti.

THE Citizens Gas Light Company, of Quincy, Mass., has petitioned the Board of Gas and Electric Light Commissioners for the right to issue $350,000 additional capital stock.

MR. J. R. DAWSON, of Springfield, who has been awarded a franchise for the construction and operation of a gas plant at St. Johnsbury, Vt., in an interview with a reporter of a local paper, respecting what is proposed to be done by his associates and himself in connection with the gas grant is reported as having said: "In the month of June, next, the St. Johnsbury Gas Company will be ready to supply gas to its customers. It will be the purpose and intention of this new Company to establish close relations of mutual interest and confidence between the customers and itself to ascertain if anything can be done in each individual case to improve the service and to remove all occasion for complaints, from whatever source; to explain in personal interviews such matters regarding the use of gas as may be of practical benefit to the consumer, and generally to make every effort to make the service rendered to the public by the Company as efficient and satisfactory as possible. The hearty co-operation, essential to the highest success of the enterprise, is earnestly requested, and will be thoroughly appreciated and we trust deserved."

IT is thought by Mr. Dawson and his associates that $65,000 will have to be expended to supply gas in quantity sufficient for the needs of its residents.

SUPERINTENDENT James Young, of the Joplin (Mo.) Gas Company, reports that the increase in send-out there this winter was beyond the reasoning hope of those who own the plant.

THE annual meeting of the shareholders in the Springfield (O.) Gas Company has been set over to a date not yet named. It should have been held the 8th inst.

"R. S. M." writing from West Chester, Pa., under date of the 12th inst., incloses this mention: "The first annual meeting of the Citizens Gas and Fuel Company, of Oxford, Pa., was held the 8th inst. As the new plant has only been in operation for about a month, a large part of the business was connected with a discussion of this plant. Reports of the officers showed that while every possible difficulty seemed to have confronted them in the installing of the plant that now everything was in working order with the exception of a big leak in one of the mains which thus far has forced them to make about twice as much gas as they need and has also kept people working along the line of the pipe. Contractor William G. Fritz was present at the meeting and arrangements were made for locating this break at once. The Company is in a prosperous condition and expects to be put on a paying basis almost immediately. Officers were elected as follows: President, James D. Burn; Vice-President, D. H. Menough; Treasurer, R. A. Walker; Secretary, H. P. Passmore; Board of Directors, George Gitt, of Hanover; H. H. Lindermuth, of York; Josiah Coue, William Pitt, of Lincoln; Levi Kirk, of Nottingham; D. M. Taylor."

The Market for Gas Securities.

The considering by the State Commission of Gas and Electricity respecting the prices that may be charged in Greater New York for gas, not to say anything about electricity, seems to give the people in charge much trouble. The legislators want one price, but in the end the Commission will fix the price. Consolidated was quoted at 172 to 173 this afternoon, and by two weeks from now it will be selling at vastly better prices. Brooklyn Union is seemingly weak, and the change therein counts for less than the change in Consolidated.

In out-of-town securities Baltimore Consolidated looks good. Peoples, of Chicago, seems to go on in a fair way. Washington, D. C, is quoted fairly at 300. Keep a good look at Detroit. It is cheap.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 Wall Street, New York City.

January 22.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	172	173
Central Union, Bonds, 5's	3,000,000	1,000	108	110
Equitable Bonds, 6's	1,000,000	1,000	..	105
" 1st Con. 5's	2,300,000	1 000	118	120
Mutual	3,500,000	100	275	290
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	107	109
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	98	104
Northern Union, Bonds, 5's.	1,250,000	1,000	105	107
New York and East River.. Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106½	108½
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	114
Yonkers	299.650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	170	180
" " Bonds (5's)	15 000,000	1,000	112	113
Bay State	50,000,000	50	⅝	..
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works,...	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000.000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	10	12
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	85
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	106¾
Cincinnati Gas and Electric Co	29,500,000	100	106½	106¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,683,750	100	..	95
Preferred	3,026,500	100	107½	108
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	84	84½
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	980,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
" Bonds, 5's	10,500,000	..	110	110½
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	.	..
Preferred	2,500,000	100	100	110
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1 000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	100⅝	101
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	.
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104½	105½
San Francisco, Cal.	15,800,000	100	58½	58¾
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's..	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,600,000	20	296¾	301⅞
First mortgage 6's	500,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del	600.000	50	230	..

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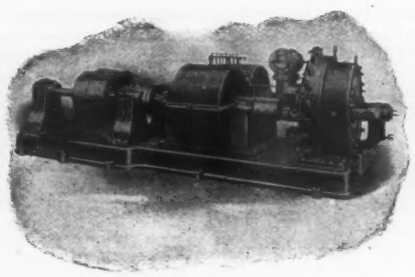

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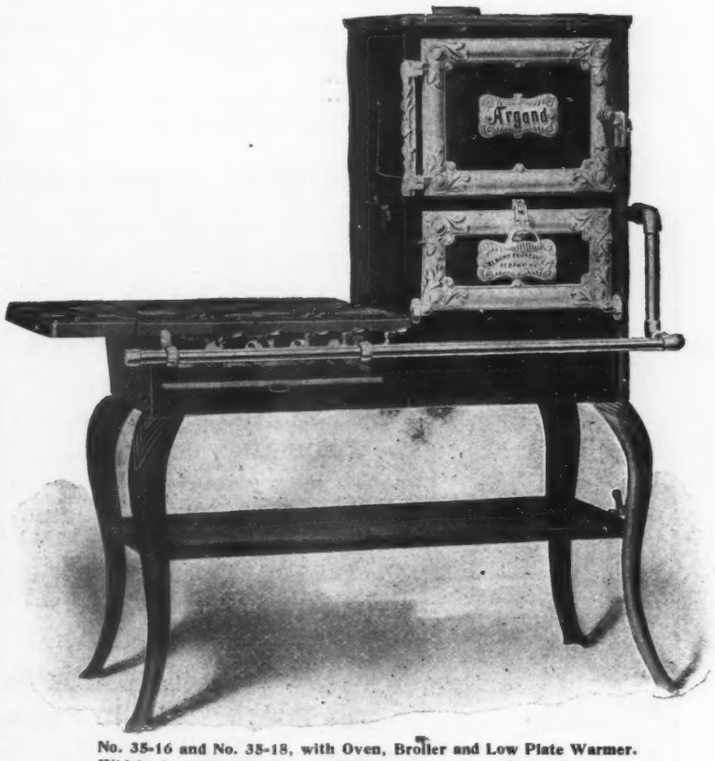

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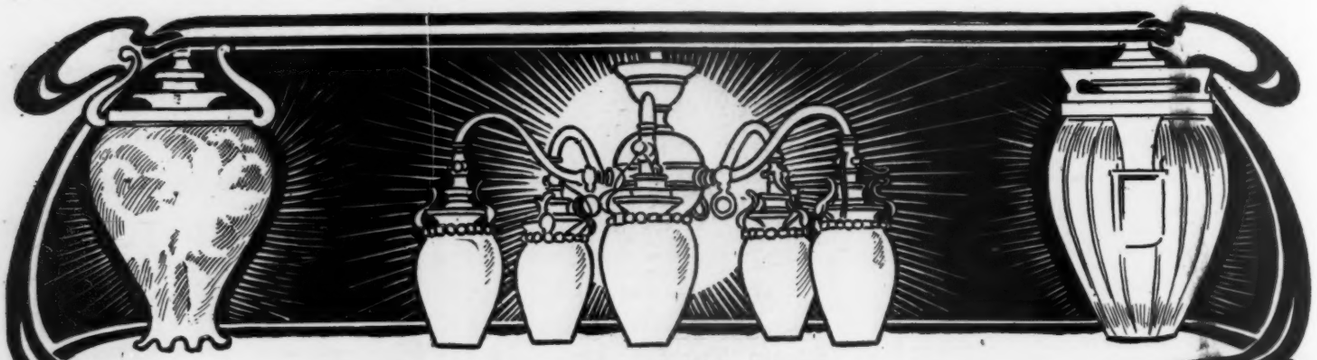

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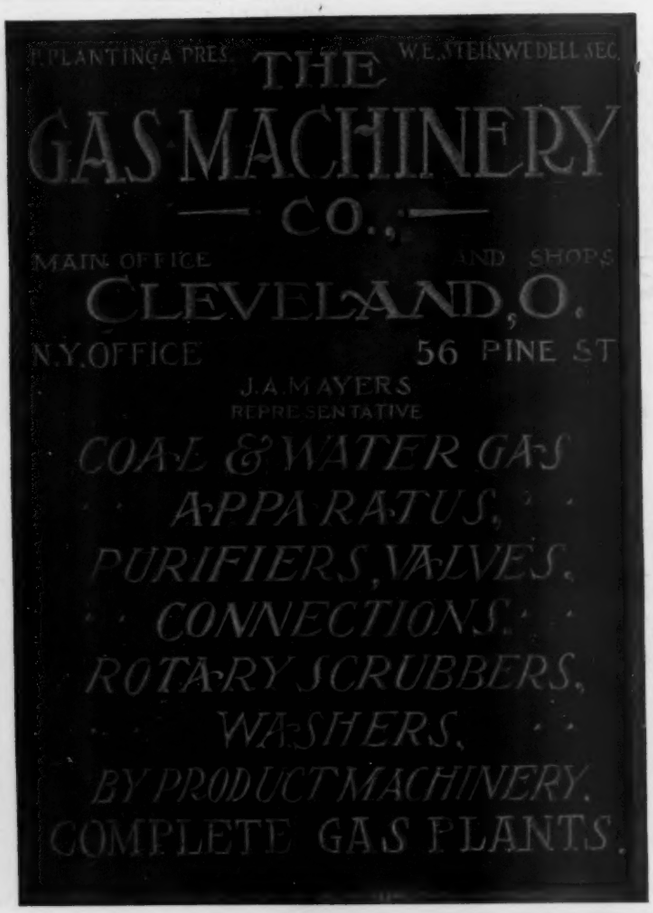

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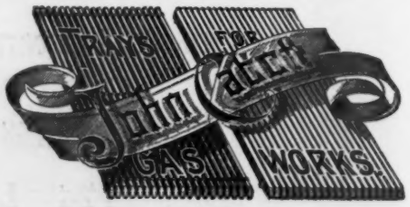

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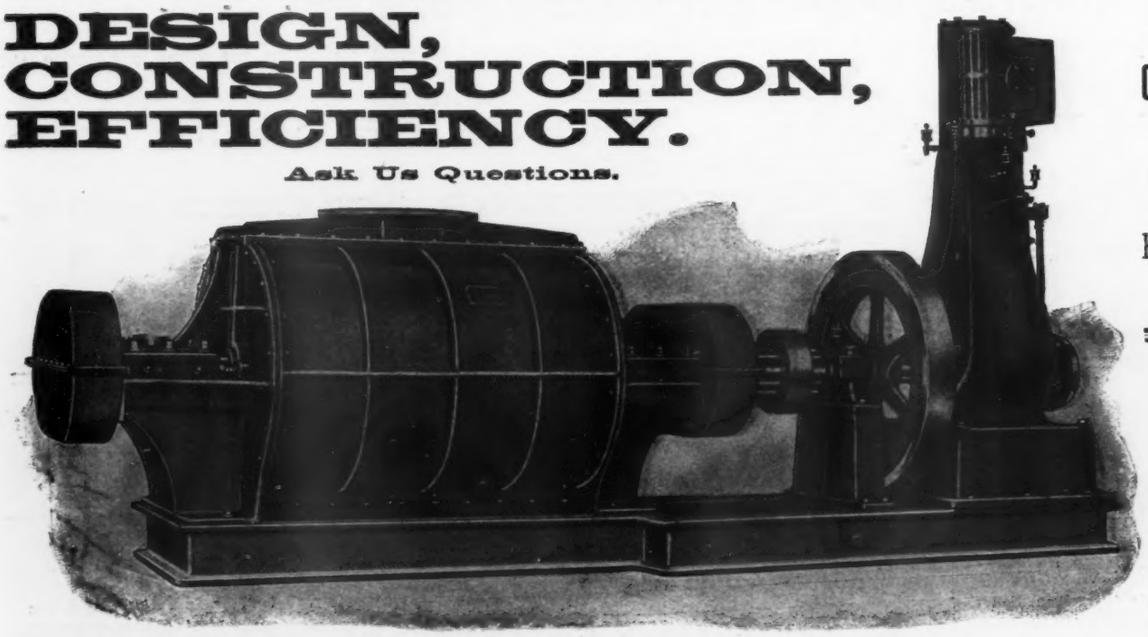

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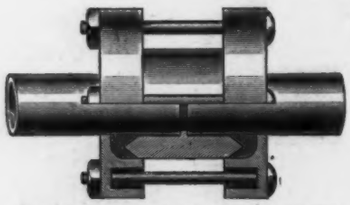

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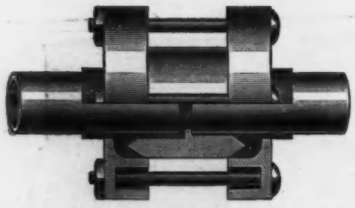

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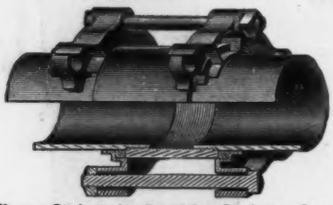

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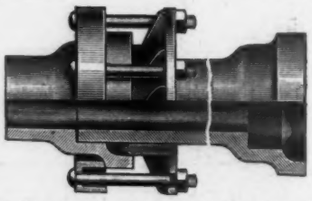

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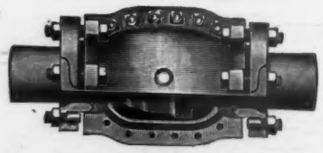

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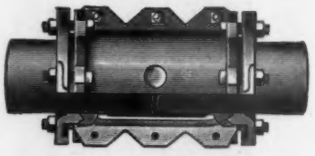

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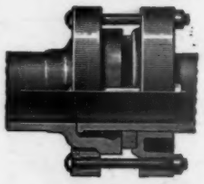

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No. Heater.	Price.	Gas Supply from Meter.	Heats Gals. per Min. 50° in Temperature.	Height.	Diameter.	Shipping Weight.
Non-Contact 2	$35.00	¾ Inch.	2½	34⅝ Inches.	12 Inches.	70 Pounds.
" 1	30.00	¾ "	2	31 "	10¾ "	62 "
Contact 6	25.00	¾ "	3	29½ "	12 "	60 "
" 8	20.00	1 "	2½	28¼ "	10¼ "	48 "
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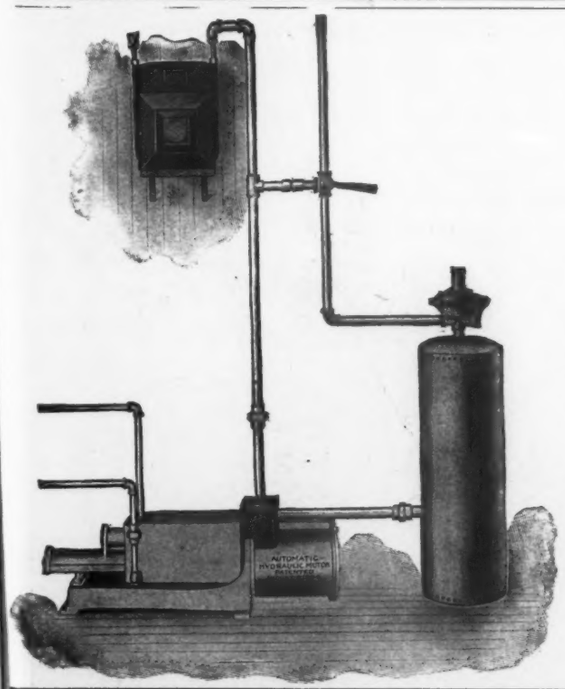

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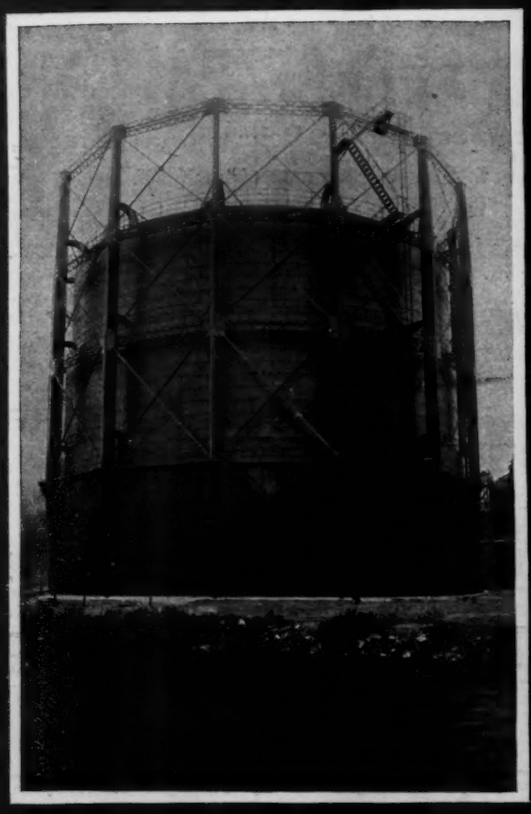

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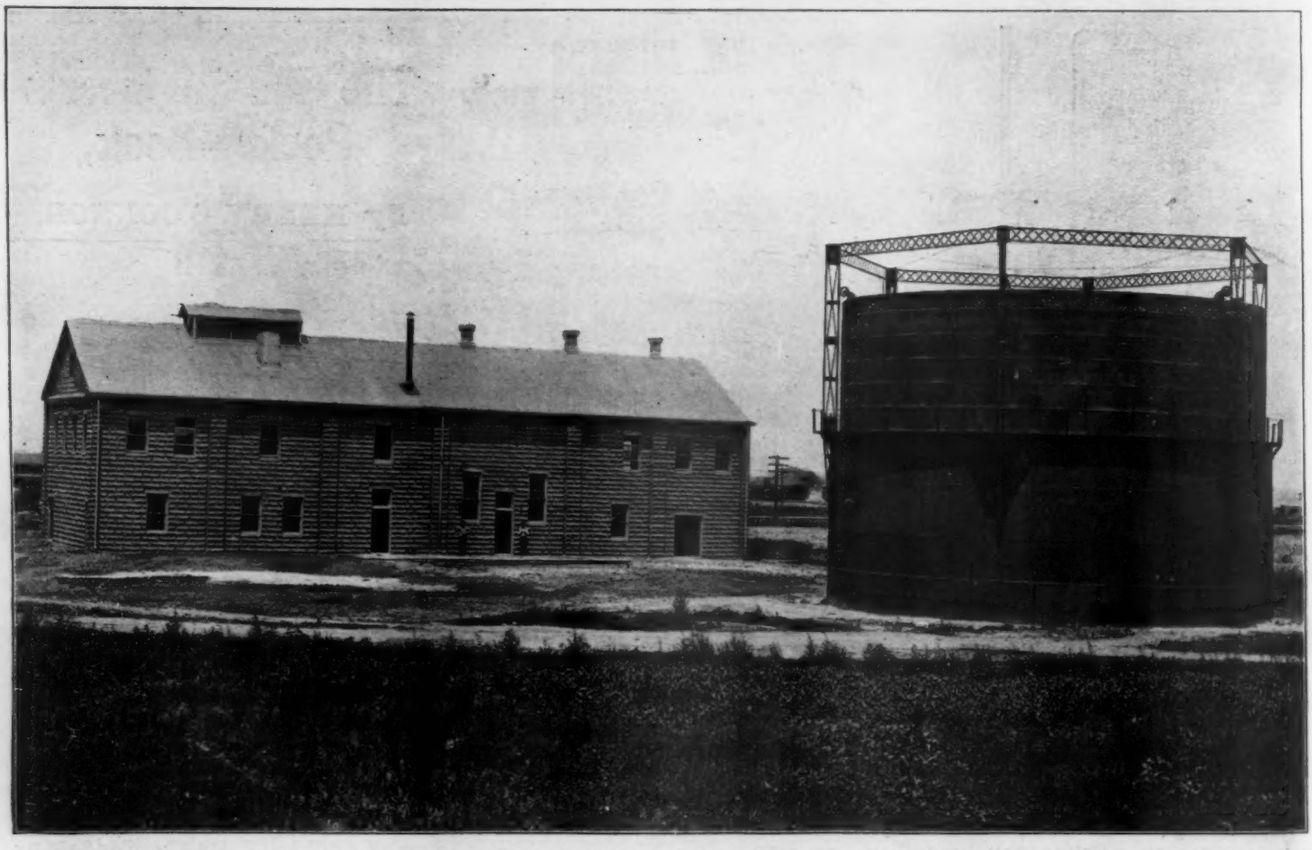

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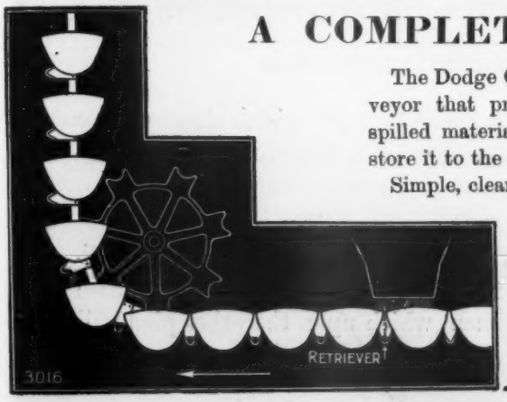

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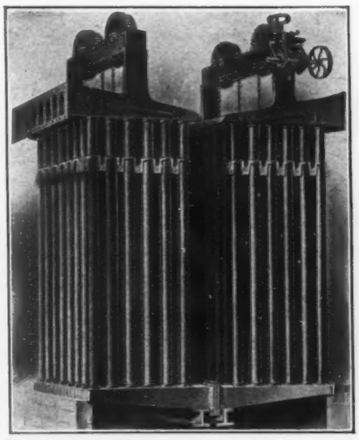

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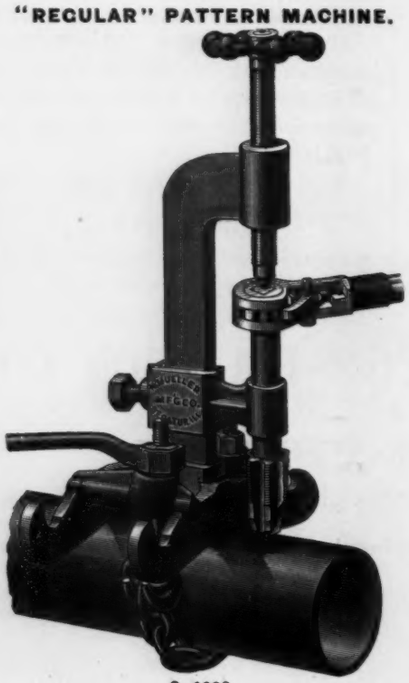

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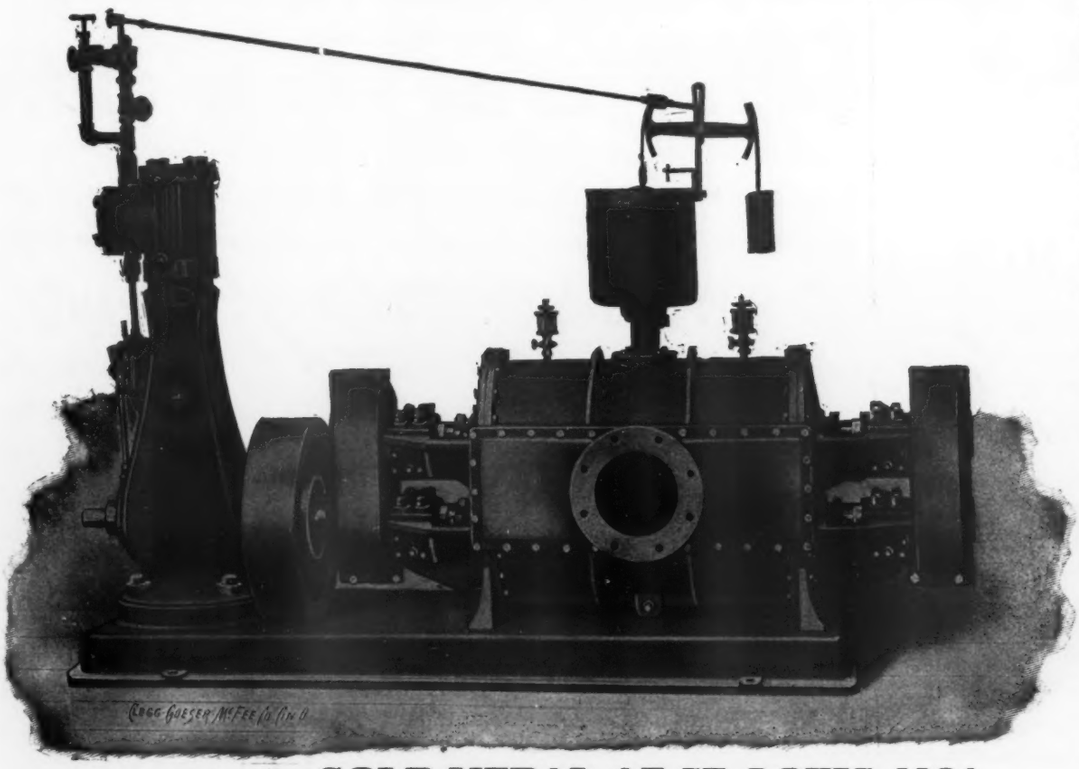

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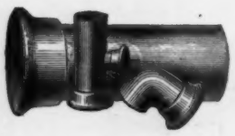

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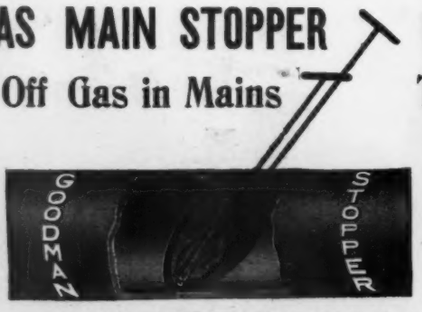

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PUBLIC LIGHTING TABLE.

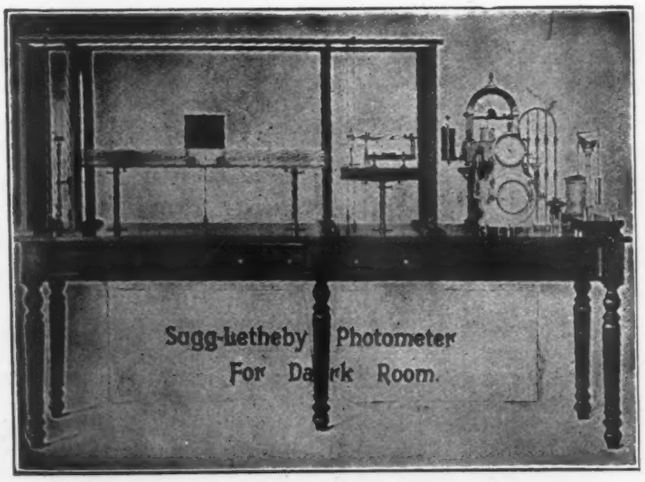
FEBRUARY, 1906.

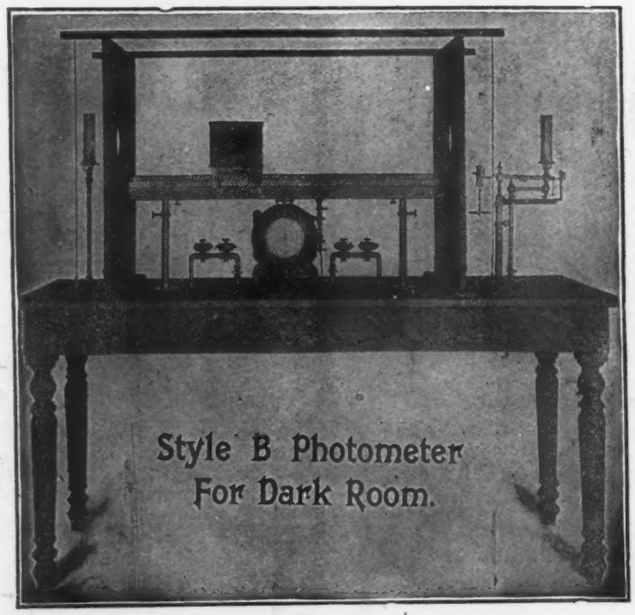
Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.
Thu.	1	12.20 AM FQ	6.10 AM
Fri.	2	1.10	6.10
Sat.	3	2.10	6.10
Sun.	4	3.00	6.10
Mon.	5	3.50	6.10
Tue.	6	4.40	6.10
Wed.	7	No L.	No L.
Thu.	8	No L. FM	No L.
Fri.	9	No L.	No L.
Sat.	10	6.00 PM	8.10 PM
Sun.	11	6.00	9.20
Mon.	12	6.00	10.30
Tue.	13	6.00	11.40
Wed.	14	6.00	12.50 AM
Thu.	15	6.00 LQ	1.50
Fri.	16	6.00	3.00
Sat.	17	6.00	4.00
Sun.	18	6.10	5.00
Mon.	19	6.10	5.50
Tue.	20	6.10	5.50
Wed.	21	6.10	5.50
Thu.	22	6.10 NM	5.50
Fri.	23	6.10	5.50
Sat.	24	6.10	5.50
Sun.	25	6.20	5.40
Mon.	26	6.20	5.40
Tue.	27	9.10	5.40
Wed.	28	10.10	5.40

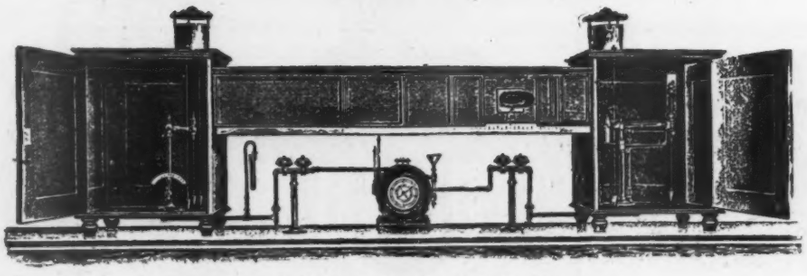
TOTAL HOURS DURING 1906.

By Table No. 1.

	Hrs.Min.
January	223.40
February	190.40
March	192.10
April	167.00
May	152.20
June	142.10
July	150.20
August	157.40
September	170.00
October	185.10
November	201.40
December	214.00
Total, yr.	2146.50







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

FEBRUARY, 1906.

Day of Week.	Table No. 2. NEW YORK CITY. All Night Lighting. Date.	Light.	Extinguish.
		A.M.	P.M.
Thu.	1	5.05	6.15
Fri.	2	5.05	6.15
Sat.	3	5.05	6.15
Sun.	4	5.05	6.15
Mon.	5	5.10	6.10
Tue.	6	5.10	6.10
Wed.	7	5.10	6.10
Thu.	8	5.10	6.10
Fri.	9	5.10	6.10
Sat.	10	5.10	6.10
Sun.	11	5.10	6.10
Mon.	12	5.20	5.55
Tue.	13	5.20	5.55
Wed.	14	5.20	5.55
Thu.	15	5.20	5.55
Fri.	16	5.20	5.55
Sat.	17	5.20	5.55
Sun.	18	5.20	5.55
Mon.	19	5.30	5.55
Tue.	20	5.30	5.55
Wed.	21	5.30	5.55
Thu.	22	5.30	5.55
Fri.	23	5.30	5.55
Sat.	24	5.30	5.55
Sun.	25	5.30	5.55
Mon.	26	5.30	5.45
Tue.	27	5.30	5.45
Wed.	28	5.30	5.45

TOTAL HOURS DURING 1906.

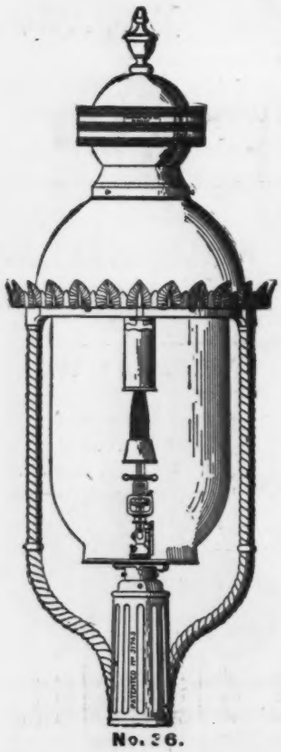
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 318 West 42d Street. BOSTON. 820 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, 218 La Salle Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....:



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

The Welsbach No. 6 Harp Fixture.

AN IDEAL LIGHT FOR DINING OR LIVING ROOMS.

THE HIGHEST MECHANICAL INGENUITY COMBINED WITH ORNAMENTAL BEAUTY--THE NEWEST OUTPUT FROM THE WELSBACH FACTORIES.

Equipped with new model No. 66 high candle power Welsbach Burner.

Side Pilot By-pass Tube covered with refractory sleeve to prevent bending.

Fourteen-inch Opal Dome Shade.

Polished Brass Embossed Crown 2¼ inches high.

Length of Fixture, 30 inches.

Width of Harp, 4½ inches.

Finished in Polished Brass.

Packed One Dozen to the Case.

List Price, per Dozen, $45.00.

We recommend equipping the No. 6 Harp Fixture with No. 4197 Intensive Brand Mantle, and the No. 306 **F. Q. M.** Clear Glass Air-Hole Cylinder.

Although the 14-inch Opal Dome Shade is standard equipment, we are prepared to furnish Dome Shades in green, pink or yellow (opal lined), and will be glad to quote prices.

WELSBACH CO.,

Salesrooms in all the principal cities of the United States.

Factories:

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CHICAGO, ILL.

THE UNITED GAS IMPROVEMENT COMPANY

For the Year Ending December 31st, 1905, has been Awarded Contracts for 40 Sets of

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PARTIAL LIST OF PLACES:

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Pattsmouth, Neb.
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Springfield, Ills.
Oneonta, N. Y. (2d contract).
Pottsville, Pa. (2d contract).
Evansville, Ind. (2d contract).
Lansdale, Pa.
Hemdstead, N. Y. (2d contract).
New Britain, Conn.
New York, Mutual Co. (3d contract)
St. Louis, Mo. (4th contract).
Sioux City, Ia. (3d contract).
Amsterdam, N. Y.
Houston, Tex. (2d contract).
Hamilton, O., (2d contract).
Indianapolis, Ind. (2d contract).
Nanticoke, Pa.
Hazleton, Pa.
Mahanoy City, Pa.
Ludington, Mich.
Ossining, N. Y.
Lancaster, Pa.
Flushing, N. Y. (2d contract).
South Bend, Ind.
Fall River, Mass. (2d contract).
Minneapolis, Minn. (2d contract).

TOTAL SETS TO DECEMBER 31, 1905, ... 593
TOTAL DAILY CAPACITY TO DECEMBER 31, 1905, 463,780,000 CU. FT.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
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OFFICE AND WORKS:
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SPECIAL HIGH GRADE REFRACTORY MATERIAL FOR BENCH SETTINGS AND WATER GAS LININGS.

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An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 36th year of publication. Compiled and arranged by JOHN W. FIELD, Sec'y and Gen. Mgr. of The Gas Light and Coke Company, London. Price, $5. For Sale by
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Manhattan Fire Brick and Enameled Fire Clay Retort Works.

Works at Weber, on the Raritan River. Middlesex County, New Jersey.
GENERAL OFFICES:
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Modern Coal Gas Benches,

With either Horizontal or Inclined Retorts, Half-Depth and Full-Depth Recuperative Furnaces.

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STANDARD BENCH IRONWORK.

Linings for Water Gas Apparatus, High Grade Fire Brick of All Shapes and Sizes, Ground Fire Clay, Ground Fire Brick in Bulk or in Barrels.

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Manufacturers of all Material for the Construction of Coal Gas Benches.

HALF AND FULL DEPTH AND FREE FIRING BENCHES,

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ESTABLISHED 1882.

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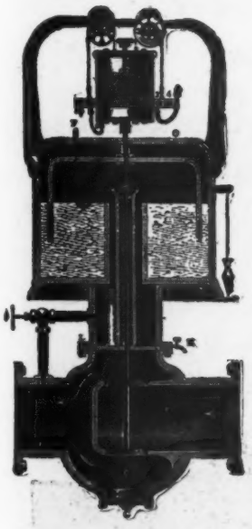

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For the Year 1904.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 36th Year of Publication.

COMPILED AND ARRANGED BY **JOHN W. FIELD,**

Secretary and General Manager of The Gas Light and Coke Company, London.

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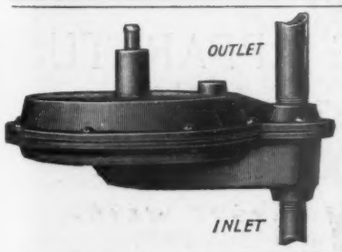

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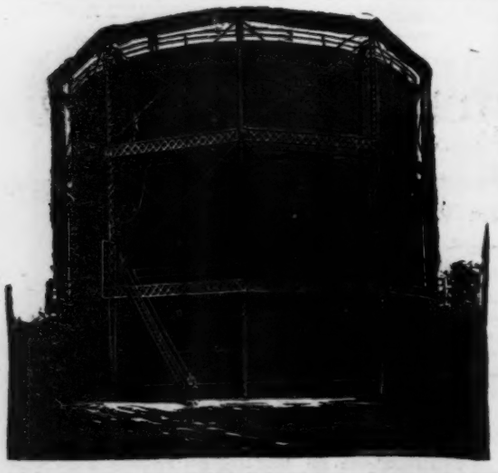

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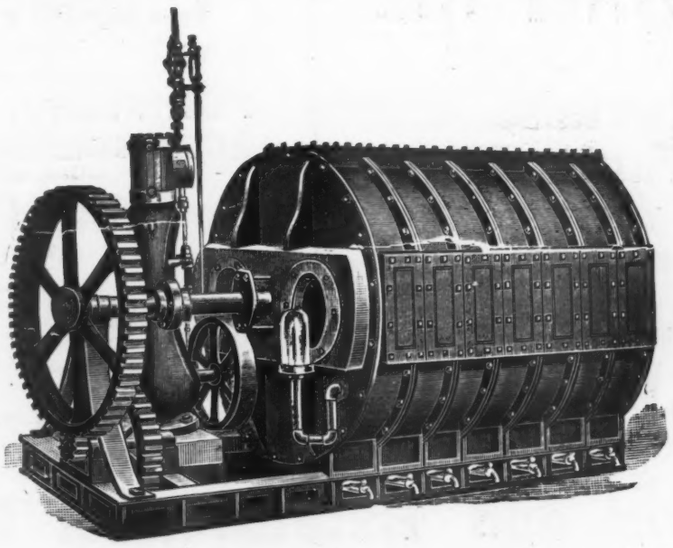

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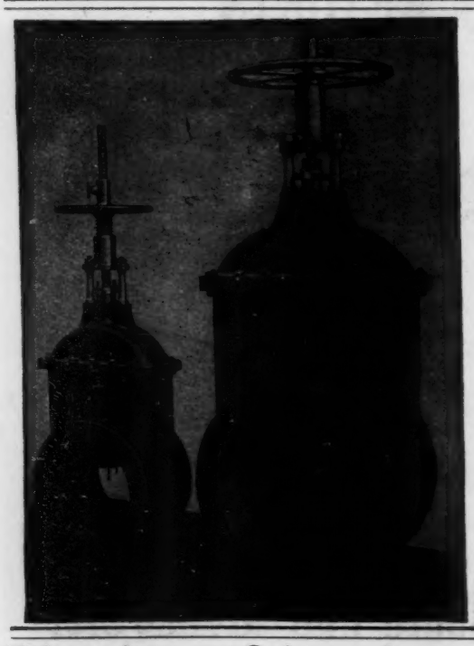

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These valves are provided with double discs or gates, and are tight with the gas pressure on either side of them.

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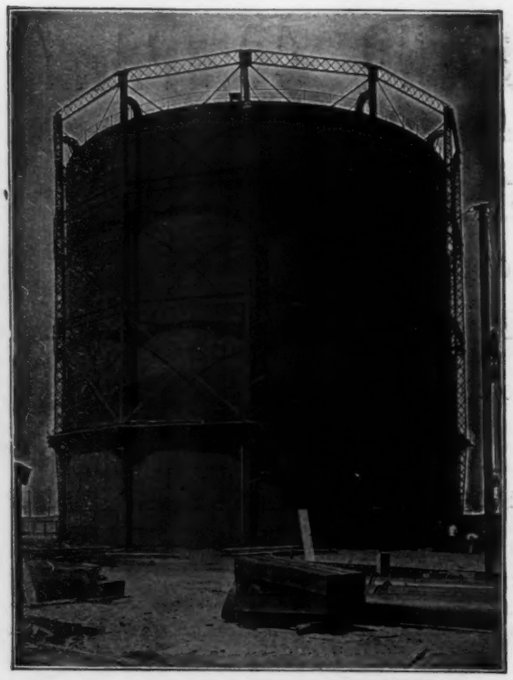

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Greater Durability

PITTSBURG METER COMPANY

KEYSTONE WATER METERS

WET AND DRY GAS METERS, PROPORTIONAL METERS AND METER PROVERS.

Main Office and Works: EAST PITTSBURG, PA.

70 PER CENT.

Of Our Output is

PREPAYMENT GAS METERS.

We have fitted up over **16,000** Idle, Regular Meters with our

PREPAYMENT ATTACHMENT.

Can be attached to any make of meter.

NATHANIEL TUFTS METER COMPANY, 8 MEDFORD STREET, BOSTON, MASS.

MARYLAND METER CO.,

LTIMORE, North and Saratoga Streets. CHICAGO, 88 to 92 Jackson Boulevard.

CONSUMERS' AND STATION METERS, PRESSURE GAUGES, ETC.

SPECIAL ATTENTION GIVEN TO ALL REPAIR WORK.

"Have you Seen our Complaint Meter?"

WHEN YOU SEND REPAIRS TO US

They can be changed to Prepayment, Prepayment and Beal Straight-reading, or Beal Straight-reading only. Good job. Good time. Good people. Write us.

KEYSTONE METER CO., Royersford, Pa.

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5-LIGHT IMPROVED METERS,

OR A

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THE QUALITY AND WORKMANSHIP IS UNEXCELLED. WE WANT TO CONVINCE YOU WE HAVE THE **BEST** AND **CHEAPEST.**

NEW YORK IMPROVED METER CO., 306 TO 310 EAST 47TH STREET.

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Wet and Dry Gas Meters, Station Meters, Meter Provers, Photometrical Apparatus, Gauges,

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Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.

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GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

This is the best time to look after your repairing.

Seventy per cent. of old meters run slow. You are losing money on them. Let us put them in shape for you, a few at a time, until your entire meter equipment is made as good as new. It is better to attend to this matter now, before the Gas Stove season is at its height. Probably we can do such work in our factory better and cheaper than you can do it at home, and just now we can do it promptly.

The BUHL METERS are as good Meters as you can get.

DETROIT METER COMPANY, - - Detroit, Mich.

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COMPLETE GAS PLANTS.
WE BUILD **"THE BEST."**

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